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The Automotive Industry and the Machine Tool Builder

Views of representative men in both industries as to improved machines and future business relations

ONE OF the serious problems that is facing both the builders of automobiles and the builders of machine tools is that of their future relations. All agree that without the machine tool builder the automotive industry could not have reached its present high state of efficient and economical production. Neither is there any question that the automotive industry provides the greatest single machine tool market that the builders have ever known. But in spite of these acknowledged facts there are differences of opinion that may seriously affect the future relations between these industries. The welfare of both demand that each see the other's viewpoint more clearly than they do at present.

One of the greatest obstacles to a thorough understanding is the wide difference in the conditions under which the respective products are manufactured. The automotive man can hardly appreciate the problems that confront a builder who knows that his market must, of necessity, be limited. Instead of having a market that can be materially widened by a reduction in price, the machine tool man knows that his most highly productive machines can be used to advantage only in a comparatively few shops.

Suppose for example, a special machine for machining both ends of a new axle at once should be developed, as it doubtless will be. The machine tool man who spends time and money in perfecting such a machine must keep the probable, rather than the possible, market in mind at all times. How many can he probably build and sell in a reasonable time? Will the automotive man encourage some one else to develop a similar machine? From the point of view of the industry this may double the cost of development and cut the market in two.

If the user really wants the best machine in such a case he must be prepared to pay for it on a basis that will remunerate the builder for his engineering and development expense, the delay to his standard production, and a profit that will enable him to develop other and better machines as necessity arises.

The machine tool builder will do well to heed many of the suggestions that follow as to convenience of operation, the use of better materials, the mounting of motors, and particularly the lubrication of his machines. Other points will also bear careful study.

Each side has naturally stated his own case and it is not to be expected that entire agreement can be secured on all points. The machine tool builder must consider his customers in other fields and this must influence the design of his standard machines. But there are many ways in which both sides can get together to the advantage of both.

In order to assist in arriving at such an understanding we have secured the views of prominent men in both industries. These views are presented herewith, not with an idea of promoting any sort of controversy, but rather that each may know the thoughts of the other and so judge as to the soundness of their views. As it is not to be supposed that either view is entirely without bias, it is hoped that a thorough understanding of the points at issue will show a middle ground on which both can meet for further development.

As the Automotive Builder Sees It

– 1 –

ACCORDING to men who are responsible for production in some of the large automobile plants, in some of which production costs have been studied with extreme care, the machine tool builder is not alive to his opportunities. Instead of presenting new ideas of machines to the builders of automobiles and consulting with them as to new machines, he either retains the old designs too long or springs new ones that do not fill the needs of the motor car builder, largely because the work to be done has not been studied with sufficient care. If plans and designs were discussed in advance, the results would be better for both.

This complaint is not directed particularly against the smaller builders. Some older concerns are prone to defer changes too long in order to cash in on their investment in patterns, tools and fixtures. Some of the most radical improvements have come from newer and smaller shops striving to break into the business, and frequently succeeding by producing machines that cut the cost of production to an astonishing degree.

– 2 –

If machine tool builders would send their engineers and designers to automotive shops more frequently and keep in closer touch with the developments of automotive work, better co-operation would result. The need for certain types of machines could be pointed out and suggestions secured as to probable ways of accomplishing the desired result. One type of machine for example might be for machining both ends of a rear axle shaft at the same time.

On machines that are not special it is advantageous to the user to be able to switch to other work. The buyer must consider if turret machines can be fitted with bar feed; if precision machines are sturdy enough to be put on production work after they become worn too much for their original purpose; if the machine can handle forgings as well as castings, should production change from one to the other; and how long the desired accuracy can be maintained.

– 3 –

Ninety per cent of the standard machine tools have more speeds and feeds, as well as attachments of various kinds, than the automotive builder requires. In most large production shops machines are kept constantly on one job and rarely if ever changed. Consequently, elaborate change-gear devices, with clutches, dive-keys, hardened gears, and so on, add to the cost of the machine without compensating advantages for the automotive shop. It should be possible to purchase machines either with or without these devices and at proportionate costs. It is recognized that the needs of other customers must be considered and that they may require all the extra parts named, but the automotive market is large enough to warrant careful consideration in all designing and machines could easily be designed to be sold either "plain" or "fancy" as desired. There are attachments, also made to go with standard machines, that are never required in automotive shops. Large numbers of these attachments that have never been used, can be found in some shop storehouses. These represent an economic waste that runs into thousands of dollars. Then too, there is the question of materials that are not always of the best, low carbon steels being used where alloy steel would be much better and cast gears where they should be of hardened steel.

The automotive production man would rather pay the same price for a plain, rigid machine than to have one with a much wider range, because the added range usually means more parts and less rigidity. The extra parts are likely to spell trouble, delay and repair expense, all of which he is anxious to avoid. As an example of the plain and rigid machine, he cites the simplified gear hobber that was designed by, or at least in co-operation with, the automotive engineers. Certain lathe and milling machine designs also show the suggestions of automobile production engineers as to simplicity and rigidity.

In some cases convenience of operation does not receive enough attention. On some radial drilling machines for example, speed changes must be made at the base of the column. As a result the operator frequently uses a wrong speed especially when the drilling is being done at the end of the arm.

There are also too many sizes of a number of machines, such as drilling machines and lathes, for economical manufacture.

– 4 –

There is, from the automotive point of view, an almost virgin field in research as to production methods. Spasmodic attempts have been made by a few machine manufacturers to determine angles, shape and numbers of teeth, of milling cutters. Speeds and feeds are also tested under varying conditions. But we are still more or less at sea as to whether the teeth of a milling cutter shall be very few in number or only moderately coarse, nor are the proper speed and feeds known quantities. A few drill makers have given valuable data as to drilling possibilities, but the speeds and feeds that they show as possible can seldom be realized owing to the inability of the drilling machine to stand up under the maximum speeds and feeds used in the tests.

Aside from these examples we know almost nothing as to the real possibilities in cutting metal. Nor do the machine tool builders take full advantage of the knowledge already secured. It was something over 11 years ago that A. L. DeLeeuw demonstrated in Cincinnati that lathe tools with certain shapes and cutting angles could be run at the astonishing cutting speed of 665 ft. per minute. Yet not a single lathe builder is taking advantage of this experiment or is making any effort to utilize this principle to increase the output of his machines. Many lathes have strength to take deep cuts, and a feed mechanism too weak to carry a broad feed. The deep cut is seldom needed, but a faster feed would directly reduce the time of machining.

– 5 –

The question of standard machine tools or special, strictly single purpose machines, is by no means settled. There is evidently a field for both types, depending on

(Continued on page 528)

As the Machine Tool Builder Sees It

– 1 –

JUST how much the builder of machines is behind in presenting new ideas affords room for an honest difference of opinion. As every manufacturer knows, much time and money are required to develop a new machine or a new method and the machine tool builder has to strike a balance between introducing new machines and earning enough from his old ones to keep the banker and stockholder satisfied. It is difficult for the automobile builder with an output that is counted in thousands to appreciate one that may be counted in tens. It is comparatively easy to spread developing and fixture charges of a hundred thousand dollars over an output of fifty to one hundred thousand cars. But it is a very different matter to absorb a like amount in a few hundred machines without charging a price that may look like highway robbery.

We all know of inventors whose fertile brains attempted to improve each machine as it was built. "Constant improvement but no yearly models" was their motto long before the automobile dawned on the scene. But few if any of them ever made a dollar and their stockholders are still mourning their losses. All admit that improvements are highly desirable, but it is absolutely necessary for machine tool builders to earn a profit if the industry is to continue to exist. If the production men will keep this constantly in mind, it will be easier to understand the problems of the machine tool builder. And without the machine tool industry there can be no automotive industry.

When it is remembered that the machine tool builder depends on new designs for his market, and on his ability to make older machines obsolete, the charge that he clings to old designs seems to fall to the ground. He cannot depend on old machines and live.

– 2 –

There is no denying that the automobile field has given the machine tool industry the greatest peace-time opportunity in its history. This opportunity, however, enabled it to build the better machines that have cut the cost of labor for machining automobile parts, almost to the vanishing point in some cases. The machine tools, designed for the most part by machine tool men, after studying the problems of the automotive builder, have made possible the production of high-grade automobiles at prices that are almost unbelievably low. And with other departments as efficient as the production and of the business, cost could be reduced much lower.

Perhaps one reason why machine tool builders do not send designers to automotive and other shops more frequently is their experience in a few cases where this has been done. Designs for new machines and methods have been prepared and submitted, only to have them sent to other shops to be built. In a few cases the originator has not even had a chance to bid, leaving the designer nothing but the original tracing to show for his labor and expense. Until some equitable basis can be found, for assuring the designer a fair recompense for his work, he will not be keen on submitting designs that may succeed only in giving an order to a competitor.

– 3 –

It is probably true that many standard machines have more speeds and feeds than are required in production work. But this is because they are believed to meet the requirements of the majority of users. For, though the automotive industry is the largest single customer, it does not use the bulk of machine tools made, except in certain lines. And machines must be built to suit all customers.

Automotive men must know that it is cheaper to build all machines alike than to make changes to suit individual customers. Hence the standard colors and equipment on all cars in large production. It is often cheaper to supply a change-gear box than to make the alteration necessary to omit it. The possibility of designing machines to be sold "plain" or "fancy" has been frequently considered, but has never seemed to be an economical procedure from any point of view.

There is very little encouragement to spend time and money in designing and building a machine that you know has a very limited field. No automobile builder would design a car that he knew would be bought by only a hundred people at most. He could not charge enough to make it worth his while. If there were some method by which the builder could secure a share of the savings over a three- or five-year period, there would be more incentive to design very special machines.

Such suggestions as that regarding radial drilling machines are definite and helpful. The criticism regarding too many sizes is true, but the user is largely to blame. When he encourages competing builders to make a standard machine an inch or two oversize, he is adding to a list that is already too long.

– 4 –

It is also true, as stated by the production manager, that machine tool builders have not continued experiments or developed the De Leeuw form of cutting tool. It is admitted that this seems to be an oversight on their part and that the possibilities of this tool should have been carefully studied.

But is this not equally a criticism of the automotive production man? He was as free to try out this form of cutting tool as was the lathe builder. If he has not done so, has he not overlooked the same possibility of saving and is he not subject to the same criticism? Is it fair to expect the machine tool builder to do all the experimenting?

– 5 –

The builder of machine tools is no more settled as to special machines than is the automobile builder. And just as the automobile builder shies at special orders, so the machine builder tries to promote the use of standard machines. A few builders, who have had sad experiences as to costs and prices, refuse to build any but standard designs.

The builders of single-purpose machines have difficulty in preventing changes on every order and the question of a "net" after the job is done is a very serious problem. If there were a larger market for these machines the problem would be greatly simplified.

(Continued on page 529)

As the Automotive Builder Sees It

the nature of the product. For such parts as front axles and cylinder blocks, a wholly special machine seems best for both milling and drilling. For cylinder bores the 4-, 6- and 8-spindle heavy-duty machines may be called special. Where reaming is done singly in the bores, the standard single-spindle machine is well suited.

For transmission-case milling, on the other hand, standard-type milling machines with special fixtures and cutting heads are probably the best. The production can be just as high as with a wholly special machine while the first cost is lower. Then, too, a change in design makes only the fixtures obsolete, or the machine can be used on an entirely different product if desired. Generally speaking, the tendency seems to be away from wholly special machines, although it seems quite possible that further concentration of models and builders may revive the demand for special machines. It is, in fact, quite conceivable that the automotive shop of the future may be largely equipped with special machinery in much the same way as is the sewing machine shop or the plant equipped for manufacturing electric light bulbs. Comparatively few standard machines are used in the former and almost none in the latter type of shop.

– 6 –

One point for machine tool builders to consider very carefully is the cost of repairs to their machines. And this cost must not include only the cost to the machine itself but also the loss in production that it causes. This cost of repairs is a big factor in selecting new or additional equipment. It is a part of the duty of management to keep an accurate record of machine repairs, both as to loss of production and the cost in dollars or hours. Machines with a bad record for repairs are not likely to receive much consideration when new equipment is being purchased.

One item affecting repair costs is the difficulty of securing replacement parts. In many cases, even with large builders, no parts lists are available and much delay frequently results before the builder understands just what is wanted and gets the parts to the user. Then too, the costs of the repair parts are frequently excessive.

The cost of these parts, together with the fact that they are not always of the material best suited for the work, leads some users to make their own repair parts. In this way cast iron can be replaced by steel and carbon steel with high-tensile alloy, thus reducing the breakage and wear.

In spite of all that has been said about poor countershafts in the past many machines are still equipped with them. Even well-built machines are sent out with countershafts that in no way compare with the machine itself. Users are replacing plain bearings with either ball or roller bearings in loose pulleys to save oilers and delays in production. The increasing use of individual motor drive is reducing this factor, but too little attention has been paid to it.

Accessibility of parts liable to wear or breakage is another item to be considered. Likewise the giving of information as to how parts should be disassembled and repaired. With automatic machinery a lack of this information is frequently a great handicap and adds to the cost of repairs as well as to the time the machine is out of commission. If, as before stated, machine designers spent more time in automotive shops, they could better appreciate the conditions under which machines must work, the necessity for continuous lubrication, the cost of even slight delays to the production line, and other factors that affect the value of machine tools to the user. Actual observation of present methods would also suggest newer and better ways of doing the work and result in materially improving machine tools. The designers should also interchange ideas with others in their own field in the same way as is done in automotive shops.

– 7 –

Bearings and lubrication do not receive the attention they should and the greater part of maintenance costs are due to these causes. In some cases both the bearing surfaces and lubrication are insufficient. In one instance at least, the user removes the heads carrying the work spindles and replaces them by heads having larger bearings before the machines go into service. A case is cited where the milling head supplied by the builder had to be taken down and refitted every ninety days, while the new head, with larger bearings and better lubrication, runs over a year without attention.

Lubrication needs very careful attention on machine tools. Even on machines with oil pumps there are usually many oil cups that must be attended to or some bearings will suffer. Some of these cups are in awkward locations and apt to be overlooked. The oil pumps are not always well located, some being in the way and others overhanging the machine so that oil drips on the floor. In one new multiple-spindle drilling machine there are sixteen oil cups, one for each spindle. All these spindles could be lubricated from a single oil reservoir and each spindle would get oil. As it is, some of the sixteen oil cups are bound to be overlooked.

Not enough attention is paid to properly safeguarding machines both to protect the worker and to comply with the state laws. It is much easier and cheaper to build guards into a machine than to add them afterwards.

The balancing of high speed parts is not done with sufficient care in some machines. Unbalanced spindles cause vibration and affect the accuracy of the work done.

– 8 –

Although there is a decided improvement in designing motor applications to machine tools, they still have the appearance of being an afterthought in too many cases. While this is merely a matter of appearance in some instances, in others it affects the value of the machine by increasing vibration, by taking up added floor space or for other reasons.

On belted machines the belts are frequently too narrow, not enough consideration being given the work to be done. Pumps for lubrication as well as for coolants are also unsatisfactory in some cases. The use of cast steel or forgings for gears, levers and cams should also receive careful attention as affecting the question of repairs.

(Continued on page 530)

As the Machine Tool Builder Sees It

The use of single purpose machines is a purely economic question in which the line is drawn by the demand of the user. If the user feels that a machine of this type will pay, he can always find some one to build it.

Both the user and the builder, however, should remember that the standard machine is the builder's "bread and butter" and that cost sheets will show that special machines rarely give a real profit.

– 6 –

The question of repairs is rather complicated. The class of operators in many production plants makes frequent breakdowns almost inevitable. Machines that stand up well in ordinary shops develop trouble in some automotive shops. Much of this is due to improper lubrication, for which the designer and builder are largely responsible. This defect is being improved and some machines are well lubricated at present.

Greater attention to information as to repairs and adjustment would be a good thing. A study of the automobile maker's instruction manual should be helpful. But we must remember that these are for non-mechanics and that the machine repairman in a large shop is supposed to know machine construction thoroughly. He should, however, be assisted in every way possible.

When it comes to the cost of repair parts, there is an opportunity for argument. Those who know what parts cost when produced in quantity are very apt to think that many automobile parts are priced at very high figures. In judging the cost of parts of any machine we must always consider the quantity in which they are made. And it should be remembered that while automobile parts are frequently made in lots of ten thousand, the machine tool part is more apt to be made in lots of ten.

Where it is found advisable to replace a part with another material than that supplied with the machine, the builder should be notified as a matter of information if for no other reason. It frequently happens that the breaking of a cast-iron part may save much more costly repairs in other parts of the machine. Then, too, cast iron makes an excellent bearing surface when the load is not excessive and many find it fully as satisfactory as steel in some places.

If, as Mr. Cardullo pointed out in discussing the able paper by Mr. Kelso at the last S. A. E. meeting, the users of machine tools will keep an accurate record of repairs and show the record to the builder, they will be doing a great service for all industry. There should be no secrecy about such records. The sooner they are common property the sooner will builders of machine tools turn out a better product, and all industry will benefit.

It is somewhat startling to have builders of automobiles complain of excessive prices for parts in view of the fact that the prices of automobile parts, if added together, average from 3½ to 5 times the cost of a completely assembled car. Some add up to a much larger proportion.

Proper safeguarding is a serious question and there is undoubtedly room for improvement. One difficulty is the great difference in state laws so that a guard that is "safe" in one state, must be removed in another. Machine builders would welcome a digest of the laws of the 48 states on safeguarding the machines they build.

– 7 –

It is admitted that there is room for much improvement in both bearings and lubrication. If it becomes necessary to replace spindle heads as supplied by the builder, it is evident that the machine was not well suited for the work. If no other machine was better adapted for the work, the special condition evidently warranted the change. But the builder should be notified, for his future guidance.

There is a trend toward positive lubrication of all bearings, but many oil cups put in out-of-the-way places are still on machine tools just as they are on automobiles. The "one-shot" lubrication idea will probably be adopted by both in the near future.

As the automobile builder knows, there is a vast difference in the sort of person using his car. In the same way the service a machine tool renders depends largely on the kind of operator who handles it.

The question of balancing is timely and important. There is no doubt that many machine tool spindles should be more carefully balanced. The same is true of many automobile crankshafts. The vibration from unbalanced engines also causes vibration, discomfort and affects the life of the engine and car as a whole.

– 8 –

The mounting of motors on machine tools is open to the criticisms made as is that of regarding the width of belts, and of pumps. In some cases the builder is not informed of the failure or the inconvenience and does not appreciate his shortcomings. It would help all concerned if the shortcomings were pointed out. A failure to correct a defect is an excellent reason for buying another machine. This also holds true for levers, cams, etc. that fail in service.

– 9 –

The expense of selling any kind of manufactured product is a serious problem. It is generally believed that the cost of selling automobiles is higher than that of machine tools, in spite of the great demand for automobiles. Similar criticisms can probably be lodged against both industries. But the production man naturally sees only the wastes in the industry from which he buys.

All of the criticisms as to salesmen, catalogs, etc., are probably true in many cases. There are undoubtedly many trips made that are unwarranted. Yet if a wild goose chase lands an order, we call the salesman a "go-getter" and perhaps boost his salary. Frequently the man who is only "planning" can be persuaded to place an order, and the salesman or the firm gambles with the expense account.

The buyer himself frequently adds much to the cost of selling. Every time he keeps a salesman waiting for an audience he adds to the cost of the sale. The demand for tooling blueprints, layouts, time study and other engineering data, makes the cost of selling mount

(Continued on page 531)

As the Automotive Builder Sees It

– 9 –

There is much unnecessary expense in selling machinery. Too many salesmen visit possible buyers without sufficient information as to their machines or their possibilities. The buyer frequently knows more about a machine from the description in the *American Machinist* than the salesman can tell him. Too many visits add unnecessarily to the selling cost.

Some users ask for information to be used in making plans for the future. They frequently request that no salesman be sent, as no order will be placed for many months. In spite of this effort to save money for the machine builder, he frequently sends a man several hundred miles where there isn't a chance of getting an order.

Many catalogs and quotations do not give sufficient data to enable the buyer to estimate the probable production. Is this carelessness or fear that the information may not be favorable to the machine? Others give full data at all times, even going to the trouble to submit proposals in attractive form with a complete analysis of the job, sketches of the tooling and fixtures, and so on. This enables the buyer to see all sides of the proposal.

The character of the builder's representatives makes a great difference in the amount and cost of sales. Too many of the representatives handle so many lines that they cannot be fully posted on the good points of all machines, and the builder's sales suffer. The sales engineer with tact and ability aids greatly in reducing sales costs, especially if the machine he sells is already known through the business papers. Others give only a formal proposal, stating speeds and feeds but not going into details as to methods.

Any buyer appreciates receiving full information as to the methods and tooling to be used in doing a job on a new machine, and the builder who supplies this information is sure to receive more careful consideration than those who do not. Complete data concerning a proposal frequently make it unnecessary for the sales engineer to spend time and money in making an additional call, so that the cost of the data might easily be offset by the saving in traveling expense.

– 10 –

Machines that have made good in the shops of the maker even on parts furnished by the buyer do not always prove satisfactory in the user's shop. Guarantee performances are not secured after the machine has been installed and tolerances are not kept within prescribed limits. One reason is that when anything goes wrong in the home shop the men know just how to adjust it at once, while in the shop of the user the men are not familiar with the details and waste time in finding the trouble. Closer co-operation between maker and user should help this condition.

There are cases where machines come into the shop in an undeveloped state, as though the builder had not taken sufficient time to test the machine thoroughly in his own shop. Any new machine is bound to develop "bugs" of various kinds and these should be ironed out before the new machine leaves the builder's plant. Where this is not done the production suffers and the machine builder acquires a bad reputation and is not likely to receive further orders for his machines.

– 11 –

A factor in placing orders is whether the tool-holding and work-holding devices of the new machine will permit the use of tools and fixtures already in the shop. A drilling machine with a table of different height from the others cannot well be put into a production line with other machines. This very fact may prevent its getting the opportunity to be tried out. Similarly, there is a tendency to standardize on one make of machine after it has proved its worth. And having standardized on one make it is harder for others to get a trial. If the same tools and fixtures can be used, the chance of trial is much better.

– 12 –

Criticism of the quality of workmanship is a delicate subject. But many machine tools are not built to standards of accuracy that the "Master Tools of Industry" should have. Machines made to make other machines should be built with great accuracy and with the best of wearing qualities. The shops building machine tools should employ the best of machines, as the accuracy of the product of a machine can be no greater than the accuracy of the machine tool itself.

– 13 –

It is appreciated that it costs money to produce high-grade workmanship but the question of first cost of a machine tool is not the deciding factor in its purchase. The manager who must have economical production does not hesitate at the first cost of a machine tool. Its value is measured in terms of production and not in the cost per pound, or of the size of the machine.

This does not mean that the machine tool builder can charge an exorbitant price for his machines as there is a limit at which it will pay to use the less productive machine. Nor is it good policy to endeavor to charge "all the traffic will bear" as the old saying goes, any more than it is advisable for automobile builders to advance prices just because of a good demand for new models.

– 14 –

Unless machine tool builders get together with the automotive industry more thoroughly than in the past they are apt to lose business in several ways. There is a constant demand for simple, rigid and more or less special machines. Are these to be built by the machine tool builders or by the automotive shops themselves? Will the machine tool builders design the new machines to meet the needs of the automotive shops or must they design them themselves, build them in their own shops or get them built where they can?

The machine tool shop is the logical place in which these machines should be built. If it is necessary for the users to build the machines they will have to take men from the machine building industry. Is this either wise or necessary?

What both industries need is to get together more closely, and the sooner the better.

As the Machine Tool Builder Sees It

higher and higher. Encouraging firms of doubtful reputation to compete with those of known quality products also adds to the sales costs.

Buyers as a whole must pay for the sales costs of an industry. Individuals may lose money and pass out, but an industry as a whole must earn a living profit. Whatever the sales cost, it must be borne by the users. And they can do much toward reducing this cost by considering how they can avoid adding to an expense that is already too heavy.

Machines are sometimes put on trial with a guaranty that the builder knows cannot be met. He hopes, however, to sell the machine by making a reduction from the original price asked. The buyer would perform a service, both to himself and the machine tool industry, by rejecting all such machines at any price. As long as builders of this character are encouraged, the worth of guaranties is jeopardized for all concerned. If buyers will encourage builders with a reputation for square dealing by discouraging the other kind, all will benefit.

– 10 –

One reason that machines fail in the shop of the user is that they are not as well supported on substantial flooring as in the shop of the builder. This is not often true in the newer and larger automobile shops, but sometimes happens where old plants have been taken over.

Where both sides are so vitally interested in securing the results guaranteed by the builder it would seem as though complete co-operation would serve both to their mutual advantage. Yet there are too many cases where there seems to be antagonism instead of co-operation.

There are, of course, cases where the machine designer has been given a free hand and where the automobile shop has been the laboratory in which his new ideas have been tested and developed. But in many instances antagonism is evident from the beginning. Instead of helping the machine builder get the most out of his machine, obstacles are thrown in the way of its production. Tolerances that have been considered satisfactory on other machines, are narrowed in order to reduce the guaranteed output. In one recent case the inspector rejected work from the new machine while passing pieces of less accuracy from an older machine. Instead of trying to help the new machine, the attitude is frequently that of trying to make it fail.

There are probably two reasons for this. One is to use the apparent failure to meet all demands as a lever to secure a lower price. The other is that the foreman or department head does not favor the new machine, either because of some personal grievance against the maker or agent, or because it has been forced on him instead of being "sold" to him before its installation. There may be some few cases where the foreman needs to be "greased" in order to have a machine succeed, but these cases are so few as to be negligible.

Any machine that has not been "sold" to men who are to use it, has a hard row to hoe and the management that forces new machines on a department foreman without "selling" him with the idea that it is the best machine for the job, is not likely to secure the greatest returns from its investment, even if the foreman does not actively oppose the new machine. It should be thoroughly understood that the more a machine produces the better for the user.

No new machine should go into a shop until the men responsible for production are more or less familiar with its new features and are interested in its success. Every man should be interested in making it do what is intended for the sake of his production costs, whether he likes the machine or its builder. Many machines have failed that could have been money makers for the users, if there had been co-operation instead of opposition in the shop where they were tried.

A little thought will show that the workshop of the user is the best possible laboratory for testing machine tools. It is impossible for the builder to secure such conditions elsewhere. And unless the conditions are the same the test is not conclusive. For, in the user's shop, the machines are handled by the men who will use them in production and who will not favor them in any way. No machine builder, or set of builders, can maintain a testing laboratory that would give results equal to those obtained by actual use. Co-operation between builder and user, and there are many cases, permits the testing out of entirely new methods under production conditions, before a machine is actually put on the market.

We are too apt to expect greater perfection in a machine we buy than in one we build ourselves. Yet it should be remembered that a new design of machine tool, built to handle some special job in a new way, is as much an experiment as is a new motor or transmission in an automobile. It may have functioned satisfactorily on the few pieces sent to the builder's shop, yet under the stress of production a few little troubles may develop. These could perhaps be easily remedied with a little friendly co-operation. But they are occasionally used as a pretext for rejecting the machine.

– 11 –

Standardization is another subject that has many angles. Just how far it is practicable or desirable is by no means settled to anyone's satisfaction. It is easier to say "standardize all tool-holding and work-holding devices" than to determine just what to use in either case.

The automotive industry has adopted standards to a greater extent than any other. It has a standard gear-shift. And yet two of the largest builders make cars by the thousand with gear-shifts that are not standard. One of these companies builds one brand of car standard, and another with a special gear-shift.

The S.A.E. has adopted many standards that are not in universal use. The standards are used when it *pays* to do so and not otherwise. When the machine tool builder can be shown that it will pay him to adopt standards, he will do so. If the buyer refuses to buy machines that are not standardized, builders will quickly conform, and the same applies to automobiles.

There is not the same chance for standardization in machine tools as in automobiles. All modern automobiles have four wheels, an internal combustion engine, clutch, drive shaft and axles driven through a differential. Machine tools vary from a single-spindle

As the Machine Tool Builder Sees It

sensitive drilling machine to a huge rotary milling machine that faces a number of cylinder blocks at once. Except for a few elements in common, standardization is hardly feasible. These facts make cooperation between machine builders more difficult than among builders of automobiles. Work-holding and tool-holding devices are machines of the same kind, can, and probably will be standardized when the users demand it.

– 12 –

There is no doubt that the Master Tools of Industry should be not only highly productive but extremely accurate. That they should be built by the best of mechanics goes without saying. And this should be remembered by automotive builders when they send employment men to machine tool centers to hire men away from the machine tool builders, as is frequently done.

It is unfortunately true that the machine tool builders have never paid wages that compare with those to be obtained in the automotive industry. This fact, together with the fluctuations in the business, makes it difficult to get, and keep, the high-grade men that should be found in machine tool shops. The men who build machine tools should be the best paid mechanics in the world. But if machine builders paid even automotive wages the price of machine tools would have to be materially increased. For direct labor is a much larger factor in machine tool building than it is in the automotive industry, owing to the quantity produced. And it is not easy to get even present prices, to say nothing of advancing them, in spite of the claim that the price is not important.

– 13 –

The automotive buyer claims that first cost is not important in a highly productive machine tool. But this statement is modified if not nullified by his policy of demanding a 100 per cent dividend from his machine tool equipment. A price that will enable the user to pay for the machine in a single year will seldom give the builder a profit sufficient to pay for the special tools, fixtures and development work necessary to produce a great machine. And the fact that the average automotive shop uses a machine for an average of five years or more, makes the one-year basis seem a bit arbitrary and unfair. Another factor that enters into the picture is that the market for these high-production machines is very limited. The more productive a machine is, the smaller its market in any given year, in the automotive industry.

The number of automotive factories is decreasing as the output is being concentrated in the hands of fewer companies. Though these few may increase their production to take care of the increasing population this increase will not provide a great market and the more efficient the machine the smaller the market.

A specific case comes to mind where the development of a new and efficient machine cost about $250,000. The maximum market that could be estimated by enthusiastic admirers was about 250 machines, that number handling all the cars likely to be built for some years to come. The development charge against each machine, on top of manufacturing costs and profits, was, therefore, $1,000. And it was an expensive machine to build. A fair price on this machine, to compensate for the limited possible sale, would have been much higher than any machine buyer would have considered that he could pay. The machines that were sold went at a price that did not cover all costs and the machine is not being manufactured at present.

The policy of refusing to buy a machine that will not pay 100 per cent dividend may easily deprive the automobile builder of a 30 or 40 per cent dividend on his investment. Perhaps if the machine builder had been a *better merchant* in the past this would now be considered as a very profitable basis in buying new machines.

It has been suggested that a more equitable basis might be found for paying for specially developed machinery by having the cost to the user depend upon its usefulness to him. In other words, that there might be a base price to be paid on delivery and, in addition, a percentage of the earning over a period of 3 to 5 years. This would make the remuneration depend directly on the value of the machine to the user.

– 14 –

It has been suggested that the large automobile builder may have to build his own machine tools. There are probably many cases where the machine tool industry as a whole would be better off if he had in the past, so far as special machines are concerned. Some of these have required so much engineering and development work as to be very unprofitable.

With the comparatively limited number of these machines that can be used, it is a question for each builder to decide as to how far he can afford to go in that line. When the users of such machines realize the amount of engineering necessary and the cost of developing special machines they will be less anxious to go into the building of them. But until they do realize this, the regular builder is sure to be confronted with the possibilities of their doing so.

It may be that a compromise will be reached whereby the user will hire the designing done by those familiar with machine tool requirements and then build the machines in his own shop. But he must learn that this designing and development must be paid for, no matter who builds the machine. With this truth thoroughly learned and appreciated, there will be less trouble in getting together on an equitable basis.

Neither the machine tool designer nor the builder has approached perfection. But is it not evident that, whether high-production machines are built as a regular product or built by the automobile men themselves, best results for all concerned can be secured by getting together and understanding each other's problems?

The reputable machine tool builder has gained a knowledge, through costly experience, that may easily cost any other builder at least an equal amount. No matter which plan is ultimately pursued the machine tool builder and the user must get together more closely to secure best results.

Why not begin without further delay?

AUTOMOTIVE PRODUCTION

S.A.E. Production Papers

These papers were presented September 14-16 at the production meeting of the Society of Automotive Engineers, held at Cleveland

Machine-Tool Needs of the Automotive Industry

By R. M. Heidey
White Motor Co.

A DISCUSSION of the machine tool needs of the automotive industry would be of value as a means of bringing to light our most urgent needs, and a concise statement of our needs should be a guide to the machine tool industry in the satisfying of them. The simple fact that we discuss our needs clearly indicates a necessity for the clarification of our demands and also demonstrates that our requirements have not been given nor are being given the proper attention.

Development in the machine tool industry started with the advent of the steam engine and for a time was closely associated with steam-engine development. For a long time activities were confined mostly to perfecting existing machines, and there was no further striking development until the automotive industry began to make demands for interchangeable manufacturing.

Machine Tools Necessary to Success

The demands of the automotive industry have given an unparalleled impetus to and have been responsible for most of the development in the machine tool industry during the past fifteen years. This improvement has been due to the rapid automotive engineering developments and keen competition, fostered by public demand for better and cheaper transportation. Without the assistance of the machine tool industry, the automotive industry would never have reached its present stage of development. In fact, the friendly co-operation that has existed between the two industries is responsible for the success of both.

A question that is causing considerable concern to many equipment engineers is the advisability of using single or multi-purpose machines. Originally a machine capable of handling a wide variety of work was used and then when that machine was used only as a single-purpose machine, a considerable part of the investment remained idle. Those machines that are of a strictly single-purpose character are economical only when production is reckoned in thousands per week. The most general demand is for machines that are especially adapted to high production and can be readily adapted also, by changes in tool equipment, to the making of similar parts of another model or to do other work.

There has been too much attention paid by the machine tool industry to single-purpose machines that satisfy the demands of only those concerned with large production of a limited line.

There is, however, a real demand in the automotive industry for multi-purpose machines, since with frequently varying production demands, it is at times decidedly advantageous to be able to change jobs easily from one machine to another, to another department or even to another plant. Standardized machines fitted with special tools for the performance of a variety of jobs should be cheaper to build and operate, and would be a source of profit to the machine tool builders and to the automotive manufacturer.

A standardized line of machines offers the following sales arguments: Lower initial cost, remoter risk of obsolescence, and higher second-hand value. It would also be possible for the user to maintain a supply of repair parts, resulting in the elimination of expensive machine-repair departments, and effect prompt repairs.

Standardization and Service

The multi-purpose machine is particularly valuable in the small shop, the service machining departments of automotive factories and also in automotive service stations numbering seventy thousand in this country. This combined field is of tremendous size and consequently permits of complete standardization with its resulting economies both for the builder and the user. Standardization of this type of equipment is attempted by all large manufacturers operating branch service stations, but standardization is only successful when machine tool service is universal.

The failure of machine tool builders to equip machines with adequate safety guards increases installation costs to a distinctly unnecessary and uneconomical degree. It is necessary for us to spend from twenty to seventy-five dollars in order to make new machines safe for our men to operate. The builders of machines should be able to equip their machines more satisfactorily and cheaply with safety guards than the customer, because a standardized practice could be followed for their individual products.

Under existing laws it is possible for machine tool builders to sell machines in Ohio, that could not be sold

The Production Meeting was held in conjunction with the seventh annual convention and exposition of the American Society for Steel Treating.

AUTOMOTIVE PRODUCTION

in New York State in the same unguarded condition. As a consequence, we are forced to provide this equipment. The automotive industry being the largest user of machine tools is thus called upon to spend large sums of money for guarding machines, since it is generally demanded that machines should be guarded for safety rather than merely for conformance to laws. A more general application and standardization of guards would greatly reduce the customer's burden.

Considerable stress has been laid upon the co-operation existing between the machine tool builders and the automotive industry. The possibilities of this co-operation, however, are only beginning to be realized. A characteristic that we in the automotive industry are peculiarly fitted to recognize, is that there has been considerably more co-operation between machine tool builders and their customers than there has been between the machine tool builders themselves.

Manufacturers in the automotive field freely give information to competitors as well as to others and permit full access to their factories with the exception of their research and experimental departments. A high degree of co-operation thus exists that often results in the solution of difficult problems and the perfection of processes.

This co-operative spirit does not exist in the machine-tool industry. However much they have co-operated with the automotive industry, they themselves have not gotten together with a comparable spirit for the working out of mutual problems. The desire to excel has predominated to the exclusion of the co-operative spirit, which would have resulted in stabilizing the machine tool industry.

The natural development of the machine tool industry has actually been retarded because their sphere of co-operation has been confined principally to the users of their products. The machine tool builders are entirely too dependent on their customers for new ideas and applications, whereas they should be leaders in the industrial field. The designing phase of machine tools should be given the same careful study that has been given to its problems by the automotive field to create wider service for its products. Progressive automobile manufacturers have to forecast to an extreme degree of accuracy the number of vehicles that they can sell for months ahead, also whether their customers will want power, economy, safety or speed. The design, research and experimental departments thus have to be considerably in advance of actual production.

The automotive industry spends millions yearly in designing and in experimenting, while the machine tool industry is not spending a proportional amount on developments of machine tools. Instead of actively pioneering, builders often are content with replacement orders for machines that have worn out. No less an authority than Ernest F. Du Brul, general manager of the National Machine Tool Builders Association, points out that since production of machine tools has been at a normal rate, but with no appreciable rate of expansion, "the machine tool industry depends rather upon replacement business than on new industrial developments." This statement indicates clearly the attitude of the industry, it stands waiting to take orders. It is not actively pioneering new fields—new and better methods.

Especially has testing, a burden that should properly be borne by the builder, been thrown upon the buyer. Generally the builder calculates a certain performance of a machine which he places upon the market; then, after the machine is delivered from a few days to several months is spent in trying to secure that performance. We recently purchased a machine and, failing to get the guaranteed performance, called for the builder's demonstrator. He remained at our plant for several months before satisfactory results were attained. This is a situation for which the machine tool builder should assume a definite responsibility instead of passing it on to the customer.

> The machine tool builder has co-operated with the automotive industry to a commendable degree. But this co-operation with the customer and not with other builders tends to make him dependent on the customer for new ideas. Design, research and experimental departments should be in advance of production. Manufacturers should be field leaders.

We recently rearranged our entire engine division and, in order to test certain machines that we intended to purchase, sent flywheels to one builder, camshafts to another, and other parts elsewhere in order to make reasonably sure that the machines we were purchasing would perform before placing them in our factory. We are probably more exacting than the majority of manufacturers, but the examples indicate the extent to which we must go in order to secure machines that perform according to our specifications.

If the machine tool builder would analyze his buying public and their needs, he would have much less to rectify after the machines were on the market. Production of today demands working to very close limits, and, when we speak of close limits, we, at the White Motor Co., do not mean in thousandths, we mean in ten thousandths. A thorough analysis of the needs of the automotive industry will give the machine tool builder greater and more stable profits.

We note with satisfaction that the committee working under the auspices of the American Society of Mechanical Engineers and the National Machine Tool Builders' Association has made considerable progress in the standardization of T-slots, which should save thousands of dollars for the industry. The automotive manufacturers would be pleased to see standardization worked out for such features as spindle noses, internal and external turret holes, lead screws, working heights and standard machine data sheets. These are not salient features of a machine and would not jeopardize its sale; yet a manufacturer who has a large diversity

AUTOMOTIVE PRODUCTION

of machines of a similar make would be able to reduce his cost appreciably, if such features were standardized.

The balancing of moving parts has been almost entirely neglected by machine tool builders. The vibration of moving parts such as gears, wheels, and shafts, which are seldom balanced, is frequently excessive and materially decreases the life of the machine. This improvement could well supplement the other standardizations that we have recommended.

In summarizing what the automotive industry needs in the way of machine tools, we desire to make the following specific recommendations to the machine tool builders:

Develop multi-purpose machines capable of using special tool equipment adapted for quick change-overs.

Safeguard all machines so that they can be put into immediate operation without extra expense.

Balance all moving parts properly so that vibration will be reduced to a minimum.

Continue co-operating with the automotive industry. Furthermore, actively co-operate with each other, since the free interchange of new ideas and developments would be of infinite value to industry as a whole.

Study the demands of your market, analyze the needs of the automotive industry, not only for today, but for the future as well, so that your dependence on replacement orders may give way to active production for analyzed needs.

The Problem of Gear Production

By Earle Buckingham
Niles-Bement-Pond Co.

THE problem of gear production is essentially the same as all other production problems. First must be determined what is required, and then suitable methods must be found or developed to produce the required results. Often the exact requirements of the parts or product in question are not fully established until actual production has been under way for some time. This fact imposes on the production effort the additional burden of requirements and then more requirements in the manufacturing operations. Such in brief has been the history of the production of almost every commodity.

The production of gears has been no exception to this common history. In many ways it is an aggravated example. In the first place, I doubt if anyone fully knows and appreciates exactly what all the essential requirements of this product are. In the second place, the demands on the performance of gears are growing more and more severe. Satisfactory gears of yesterday are not satisfactory today. Satisfactory gears of today may not be satisfactory tomorrow. In the third place, although many different methods of producing gears are now available, no one of them has yet proven itself to be best in all features.

> The design and manufacture of gears must constantly progress to meet the growing demands, especially of the automobile industry. We are hampered, at present, by the lack of rapid testing devices. The finishing of gears to produce smooth and even action seems to be accomplished most efficiently by form grinding, generating proving less successful.

The first essential to satisfactory production is suitable means of measuring the results obtained. We must be able to detect and to measure definitely any troublesome errors before we are in position to correct them. Here again we are at a disadvantage in the production of gears. Many valuable and ingenious testing instruments for measuring the various elements of a gear have been devised; but almost without exception they are more in the nature of laboratory instruments than every-day shop testing tools. Such laboratory instruments have their place to fill, but production requires testing means that are simple, rapid and effective. Until we know, however, exactly what conditions on gears need continual watching, we are at some disadvantage when we attempt to evolve such facilities. This is the principal reason why such testing means have not yet made their appearance. Despite this lack of the first essential, production must be maintained. In fact all production is more or less carried on in spite of inadequate information and equipment rather than because of complete facilities.

Not knowing exactly what we must produce, we must proceed to consider ways and means for producing it. We do know, however, that on gears very small errors make very large troubles. Small errors in profile or small errors in spacing become very apparent to the ear when the gears are operated under load. In addition, since considerable sliding action exists between the gears, smoothness of profile is essential. Furthermore since most of the gears used in automotive construction must carry high loads and often withstand considerable abuse, they must be hardened. Thus the production department is called upon to meet a very high degree of precision under the most unfavorable conditions.

Many methods of machining gears have been devised. These methods may be roughly divided into two general classes: First, forming; and second, generating.

The forming process is the oldest, and is represented by form milling the soft blanks and form grinding the hardened blanks. To obtain results by this method involves the difficult tasks of maintaining the proper form on the cutter or grinding wheel and also of maintaining

AUTOMOTIVE PRODUCTION

it in its proper position in relation to the blanks. The difficulties encountered here led to the development of various generating processes.

These generating processes may be divided into two general types; the first where the generating tool represents the form of the basic rack of the gear system, and the second where the tool represents one of the gears of the system. Here, as before, the form of the tool is of the utmost importance, but its position in relation to the blank has little influence on the profile of the gear produced except as regards tooth thickness.

The hope that a generating process would eliminate all trouble in the production of gears has never been realized. Generating has eliminated some of the difficulties encountered in the forming process but it has also introduced a few little difficulties of its own.

A burnishing process has been developed that smooths the profiles of machine gears by crowding them into accurate hardened and ground burnishing gears. This process will make a good gear better but it will not make a bad gear good.

Profile Grinding

One thing after another has been tried to eliminate or to minimize the difficulties of producing good gears. First one thing and then another has been blamed for the trouble. More and more requirements have been introduced in gear production methods. The accuracy of the generating tools was questioned. As a result, these tools are now usually ground on the profile to correct them. Then the distortion in the gears due to hardening came in for the blame. As a result of this, profile-grinding machines were introduced.

Refinements cost money. The usual order of the day is to reduce production costs. Sooner or later this must be done. But it is a very difficult thing to refine the methods and reduce the costs at the same time. The final correct solution, if it is ever arrived at, must do this, however. This reduction in cost may come from a reduction in the amount of scrap and salvaging charges. It may also come from the eventual development of a manufacturing process that produces better work with less productive effort. It has been done in the case of cylindrical surfaces by the development of cylindrical grinding machines and a similar development may take place in the production of gears.

The introduction of gear-tooth grinding has not yet of itself cured all troubles. In the first place most of these machines are made adjustable. For this reason they are very flexible as regards the product—a very desirable feature in jobbing machines but a detrimental feature in many ways for production machines. Ease of adjustment makes it possible to correct faults readily but it also makes it possible to introduce faults just as readily. Here simple testing means are needed.

The Human Equation

To my mind, the largest part of this production problem, and all production problems, is the human equation of the workmen who are to operate the production equipments. The modern plan of subdivision of labor tends to eliminate all interest on the part of the workman in what he is producing. This plan seems to be a necessary evil under present industrial conditions.

At the present time in the majority of cases the amount of skill or technique required of an operator is relatively small. The production of the complex surfaces of gear teeth, however, still requires considerable technique on the part of the operator if the best results are to be obtained. This is particularly true of the grinding processes. At the present time, as much depends upon the machine operator as upon the machine.

Production methods for gears are still in the course of evolution. The wonder is that such good results have been obtained despite the many handicaps, rather than that the problem has not been solved completely. The subject of gears is receiving very wide attention at the present time. Private interests as well as engineering societies and trade associations are working hard to clear up many uncertain features. Considerable research is necessary before all points can be cleared up. In the meantime our best course of procedure is to make sure that our designs give us, to meet the problems, the most favorable conditions of which we know; to make sure that our production equipment is kept up in the best shape possible; to discoruage carelessness in the sharpening of tools, mounting and handling of blanks, etc., and to hope for the best.

Analysis of Machine Tool Maintenance

By A. R. Kelso
Continental Motors Corporation

CONSIDERED as a generality, the maintenance of machine tools, when analyzed, brings to light some rather startling details. The repair time required per month for each machine is too great. The combining of sales points and fundamental principles so as not to sacrifice one to get the other constitutes good design. Unfortunately, due to the drive for modifications, the need for improving the existing fundamentals has been neglected and the reliability that should exist has not yet been attained.

The largest single expense item that concerns the machine is due to maintenance and lost time. Ordinarily the productivity of the machine is the measure of its worth, but if it is idle and piling up repair expenses for long periods, then its advantage when compared with a somewhat slower and more reliable machine becomes somewhat doubtful, for it must be considerably faster to be economical.

We will deal first with the analysis from the repair and maintenance viewpoint, for the purpose of showing in what ways machines would be better if narrowed down to a few types; second, with the general conditions of machines in operating efficiency and also the general weakness found in machines; third, with the necessity for keeping equipment in first-class condition

Abstract.

AUTOMOTIVE PRODUCTION

to keep down repairs and maintenance based on the cost of the machine.

Reports as to the condition of equipment, and the amount spent on each, place each foreman on a basis comparable with that of the others. The data collected afford a good basis for judging the operating efficiency of each class of machines. An assumption is made that all machines of the same type produce equally, but weight must be given to the relative productivity, the accuracy and the quality of work that the machines produce before a final disposition can be made.

We will consider the following eight classifications: centerless, external, internal and surface grinding machines; automatic screw-cutting machines; horizontal and vertical milling machines; gear-cutting machines; multiple-spindle drills; turret lathes and drills.

The method of analyzing the repairs was to obtain the machine number, the job and hours spent in repairing, from the repair ticket. As in Table I, the data were summarized at the end of the month in regard to the percentage of the total number of machines repaired, the total repair hours, the repair hours per machine, the percentage of repairs according to the elements of the machine and a determination of the machine efficiency.

Before this was begun, however, several months were spent in getting the equipment into the best possible condition. More than 300 grinding machines of 24 makes were considered. Not all are included herein because, where only a few of one kind were analyzed, a prejudiced analysis might result unless it were carried over a long period.

Table I—Analysis of Machine Repair

Kind of Machine	Make or Type	Total Number of Machines in Use	Frequency[1] Per Cent	Average[2] Extent, Hours
Grinding				
Centerless	A	6	81.4	13.51
	B	10	65.6	6.93
External	C	69	63.6	8.28
	D	78	65.0	7.36
Internal	E	16	63.5	3.64
	F	19	64.0	4.45
	G	25	77.0	8.94
Surface	H	8	20.0	1.24
	J	9	38.0	2.46
	K	13	75.0	8.39
Average		253	61.4	6.52
Automatic Lathes	L	9	77.4	7.96
	M	56	51.0	5.91
	N	65	65.0	6.54
Average		130	64.5	6.80
Horizontal Milling	Ra	29	46.0	3.07
	Rb	10	46.0	2.73
	Rc	15	51.8	4.31
	S	15	48.0	2.27
	T	7	21.0	2.41
	U	10	30.0	2.38
	V	19	30.0	2.72
Average		105	38.9	2.84
Vertical Milling	AA	3	6.6	1.27
	AB	11	47.0	3.50
	AC	3	33.3	5.63
	AD	3	6.0	0.10
	AE	23	30.0	4.30
	AF	3	26.0	3.23
Average		46	24.8	3.00
Gear Cutting	BA	100	18.0	0.125
	BB	63	47.0	2.050
	BC	15	58.0	3.820
	BD	97	58.0	3.580
Average		275	45.2	2.394
Multiple-Spindle Drill-Press	CA	41	67.0	11.30
	CB	28	71.0	8.09
	CC	8	72.4	10.58
Average		77	70.0	10.00
Turret-Lathes	DA	15	40.0	2.73
	DB	14	74.0	21.05
	DC	9	62.5	2.94
	DD	69	61.2	4.88
	DE	12 (?)	70.0	5.77
	DF	138	42.4	3.41
Average		315 (?)	58.3	6.89
Single-Spindle Drills	EA	12	35.3	0.88
	EB	18	32.0	0.82
	EC	67	18.0	0.66
	ED	11	18.0	0.68
	EF	46	39.0	1.29
	EG	36	50.0	4.63
	EH	80	39.2	2.83
	EI	24	31.4	2.35
	EJ	15	26.7	2.31
Average		309	32.2	1.83
Two-Spindle Drills	FA	22	28.0	0.88
	FB	14	24.8	1.45
	FC	15	41.5	4.63
Average		51	31.4	2.32
Three-Spindle Drills	GA	15	29.0	0.78
	GB	10	35.0	3.13
Average		25	32.0	2.95
Four-Spindle Drills	HA	6	51.3	4.53
	HB	8	72.0	5.36
	HC	5	20.0	0.61
Average		19	47.8	3.50
Six-Spindle Drills	JA	8	65.50	11.85
	JB	5	40.00	1.94
	JC	5	80.06	9.16
Average		18	61.80	7.68

[1]Frequency is defined as the average percentage of the number of machines in use that are taken down for any repair during the month.

[2]Extent is defined as the average total time spent on repair divided by the total number of machines.

The first item of note is that 60 per cent of the grinders would be dismantled every month for an average repair time of six and a half hours. For a comparison of the performance of makes of machine, let us consider the external grinders of which nearly an equal and sufficient number of machines of each make is provided.

The figures on the internal grinders are not truly comparable, since too great a capacity difference exists. However, the figures are valuable as indicating that machine tool builders should devote more attention to the reliability factor of their machine.

The second analysis, Table II, showing the chief causes for repair, indicates that the predominating repair is on the feed mechanism. Horizontal millers

AUTOMOTIVE PRODUCTION

are usually more rugged. Table III shows the consistency of the type U and type V makes of machines very clearly. In the type S machine, the frequency of repair is high but the repair is low. With reference to type R machines, it is noted that the frequency of repairs is about equal on all, although the extent, in hours per machine, is higher for the general machine.

There are four makes of gear-cutting machines, 100 of the type BA and 97 of the BD machines; hence, one machine makes a difference of only 1 per cent and the percentage for frequency is a true measure of

Table II—Showing Chief Causes of Repair

Machine Part	Grinders	Automatic Lathes	Horizontal Milling	Vertical Milling	Gear Cutting	Multiple Drills	Turret Lathes	Drills
				Per Cent				
Spindle and Bearings	35	7.0	15.0	9.7	28.0	48.2	7.00	25.40
Feed Mechanism	15	35.0	30.0	40.2	21.0	16.0	19.70	14.75
Main Drive	8	8.0	5.6	24.1	7.5	12.0	9.60	34.50
Pump	6	6.5	10.6	2.0	12.2	1.8	4.20	5.50
Clutch	4	6.0	12.0	3.0	2.5	.....	6.00	.....
Workhead or Table	6	.....	3.0	2.6	4.6	.....	.....	.....
Overhauling	7	.....	9.4	.....	5.0	.....	12.00	.....
Chuck	.....	9.0	.....	.....	.....	.....	.....	.....
Cross-slide	.....	3.0	.....	.....	.....	.....	.....	.....
Bearings	.....	2.0	.....	.....	.....	1.4	3.00	.....
Index	.....	.....	.....	6.5	.....	.....	.....	.....
Cable or Chain	.....	.....	.....	.....	.....	12.0	.....	.....
Turret	.....	.....	.....	.....	.....	.....	14.84	.....
Air Chucks	.....	.....	.....	.....	.....	.....	8.80	.....

the performance. There is a 40 per cent difference in frequency of repair and a difference of 3.455 hours per machine in maintenance time per month. With 100 machines we have 3,455 more hours off for one make than for the other make, or, if we consider that they were all of the one make, more than 678 hours additional service time per month between the makes.

Table III—Comparison According to Months of Service

Type of Machine	Number of Months	Frequency, Per Cent	Extent, Hours
RC	5	60	3.13
	4	53	3.75
	3	53	2.85
	2	40	6.50
	1	28	5.30
S	5	54	3.05
	4	40	2.76
	3	53	3.76
	2	33	0.83
	1	33	1.03
U	5	30	2.50
	4	20	4.10
	3	30	0.70
	2	40	1.83
	1	30	2.83
V	5	31	1.76
	4	26	1.33
	3	35	6.22
	2	37	2.40
	1	21	1.93

Table IV—Excess Repair Time for 5 Months

Machine Number	Kind of Machine	Duration, Number of Months	Excess Repair, Hours
2-4	Double-End Press	1	0.00
		2	4.75
		3	11.50
		4	12.50
		5	30.25
2-6	Turret Lathe	1	10.75
		2	0.00
		3	7.00
		4	18.50
		5	24.50
2-7	Multiple Drill	1	19.00
		2	14.10
		3	2.10
		4	14.80
		5	24.50
2-9	Riveting Hammer	1	0.00
		2	29.15
		3	42.40
		4	5.20
		5	30.50
2-5	Turret Lathe	1	19.00
		2	12.50
		3	11.00
		4	2.75
		5	18.25
6-2	Lo-Swing Lathe	1	14.75
		2	10.65
		3	20.25
		4	0.00
		5	0.00
5-5	Crank Grinder	1	8.75
		2	21.75
		3	43.00
		4	4.00
		5	38.50
1-2	Crank Grinder	1	0.00
		2	13.80
		3	0.00
		4	6.00
		5	0.00

Eliminating the BA machine, which is so far superior to the others, there is a frequency of repair of 54 per cent and an extent of repair of 3.15 hours per machine in use. This latter figure is low, compared to machines as a whole, but it is high compared to the BA type.

Multiple-spindle drills have a high repair rate due to spindle trouble, but this is to be expected. Turret lathes apparently should have a frequency of not more than 40 per cent, and are in a class with milling machines. The type BD machine would bring the extent of repair per machine down to 5.426 hours.

Upright drills show the lowest number of repair hours for repairs per machine. On the four-spindle and six-spindle machines, one make in each is outstanding and popular in the automotive industry.

Table II, showing the chief causes for repair over the period, gives an idea of the prevalent weakness in each class of machine. Spindle and spindle bearings and feed are the greatest repair items, the main drive and the clutch are next and pump trouble comes in for a larger share than is its due. Better design and the use of strainers would eliminate most of the trouble here.

To focus attention on machine repair costs and care of the equipment, it was assumed that a certain

AUTOMOTIVE PRODUCTION

amount of repair is necessary and legitimate. This amount of repair time was worked out on a basis of 4 hours for every $1,000 cost of the machine. Such a schedule, furnished each month to the foreman gives the information that is lacking in the first general analysis, that is, what particular machines are causing the high upkeep and what machines are in such bad shape that they should be removed until put in first-class condition.

Table IV gives the figures of excess repair time spent on certain machines for five months. Machine No. 2-4 is an example of how the excess increases as the general condition of the machine becomes worse. If all the machines of the same kind appeared on the list, it might indicate that the budget was wrong; but, where only one or two machines keep reappearing, it locates the cause specifically.

Machines Nos. 5-5 and 1-2 are of the same make and type; the former machine is requiring twice the average amount of time of ten hours shown in table I for grinders, and, after appearing on the excess-maintenance list each month, shows no sign of improvement. The common case is one in which a repair is made and then the machine functions normally again.

If a machine appears on the excess-repair sheet for three months in succession with an excess figure of twice the budget time, then it would be better to spend a considerable sum in one lump for thorough rebuilding rather than to drag out the process. Generally speaking, a complete overhauling amounts to one-half the original cost of the machine.

The budget allowance may be criticized because it appears to handicap the more expensive machines of the same type. This can be afforded, for the additional investment required has one of two purposes, either to increase the quality or the production proportionally or to keep the maintenance uniformly low. If it were possible to do so, it would be better to base the budget on the increment of value that the machine gives the product.

This, however, appears as the selling price of the machine and hence it is justifiable to use it as the basis. A machine purchased second hand is handicapped because it is not allowed the same budgeted hours as a new one unless the budget is based on the cost when new.

The allowance of time for normal maintenance is mostly for what had best be called "adjustment." If a machine were perfect and taken care of ideally, then it ought to be taken down for complete overhauling before it requires a multitude of parts replacements. This brings up the point of new machines, which should use but little of the budgeted time for the first year. If they appear on the excess-hours sheet should it not be an indication of the manufacturer's fault and covered by his guarantee?

The frequency of repair for machines is high, as a whole, the percentages found being, for grinders 61.4; for automatic lathes, 64.5; for horizontal millers, 38.9; for vertical millers, 22.2; for gear cutters, 45.2; for multiple-spindle drills, 70; for turret lathes, 58.3; and for drills, 32.

It should not be unreasonable to expect 20 per cent as an index of reliability of all machines. There are in extensive use gear cutters, milling machines and drills that show less than that in this analysis.

Inspection Methods

By C. J. Ross
Buick Motor Co.

INSPECTORS have been called a necessary evil but there is no longer the incentive to learn a trade, for any novice can be taught to insert a cotter-pin on a piecework basis and earn better wages than he could by serving as an apprentice in learning a trade.

When unskilled labor is used in assembling, the only way in which the product can be held to the required standards is to make the component parts fit accurately. With adequate inspection, parts can be held to closer limits and cheaper labor can be used in the assembling process.

As soon as production is begun on a new model, a finished car is brought in and torn down to see how closely it complies with requirements. This is repeated every two or three days. Motors are checked every day. Detailed reports of breakdowns in service are received monthly from every distributing territory and from seven to fourteen cars are kept constantly on the road in tryouts.

As worked out by our company, a certain ratio of productive hours to inspection hours is allowed in each plant, the number varying in the different plants and depending upon the nature of the work. This system practically amounts to the working out of a budget. Each plant must live within its allowance.

In March, the average size of these operating units of inspection throughout the entire plant was 12.75 men per inspector; on May 30, the ratio was 11.28; and for the week ending August 8, it was 13.3.

When computed on a basis of $100 worth of productive labor, the average number of inspection hours for the entire plant for the year ending Aug. 31, 1922, was 13.9; for the year ending Aug. 31, 1923, 13.0; and for the year ending Aug. 31, 1924, 12.5. Similarly, the number of inspection hours per $100 worth of productive labor required for several of the major units is given in table I. The results are those shown in table II when the computation is reduced to the number of inspection hours per unit part. Table III gives the budget for the week ending Aug. 8, 1925.

The inspection department is divided into four divisions, each of which is under the jurisdiction of a divisional inspector who reports directly to the general superintendent. In general, inspection by pin and snap gages of the go and no-go type has been found to be the most satisfactory; they give quick inspection and are considered superior to micrometers for this work.

Abstract.

AUTOMOTIVE PRODUCTION

The metallurgical department includes large and well equipped laboratories with facilities provided for making accelerated corrosion tests on metals, fatigue tests on springs, tensile and compression tests on steel and cement, hardness tests by the Brinell, Shore and Rockwell methods, transverse tests on fabricated parts such as axles, torsion tests, impact tests by the Izod method, drop tests on wheels and other tests of a special nature.

The heat-treating furnaces are equipped with recording pyrometers and automatically controlled burners and a checking system is employed that practically prevents incorrect temperatures. The different processes that affect the strength and toughness of the part are carefully supervised and the finished article is tested to make sure that the desired quality is maintained.

All incoming steel is received and classified according to heat number and two or more samples from each heat are analyzed and, in some cases, subjected to physical test before acceptance. Such materials as babbitt are examined under microscopes.

A rather novel method of inspection extensively used is the spark test, a rapid method of determining chemical composition. This test, although by no means new, has only recently been adopted as a routine method of inspection on large-scale production.

Table I—Inspection Hours per $100 of Productive Labor

Name of Part	Sept. 1, 1921 to Aug. 31, 1922	Sept. 1, 1922 to Aug. 31, 1923	Sept. 1, 1923 to Aug. 31, 1924
Motor	3.5	3.8	3.7
Axle	0.9	0.9	1.0
Transmission	0.8	0.7	1.0
Forgings, ton	...	...	4.4
Average for entire car	12.3	11.5	11.3

The spark test depends on the fact that minute quantities of certain elements in steel alter the appearance of the sparks emitted when the material is ground on an abrasive wheel. Carbon, the most important element in steel, excepting iron, has a very pronounced influence on the spark. In testing medium and low-carbon steels by this method, the carbon can be determined within 0.02 to 0.03 per cent by using a suitable standard of known carbon-content. Nickel in steel also gives a characteristic spark, as do chromium, tungsten and vanadium. In sorting mixed stock, the spark test is of very great help. Individual bars can be rapidly and cheaply "sparked" and placed in their proper classifications. A binful of stock can be sparked on the ends of the bars without removing or handling the material by a small portable grinder.

The Brinell, Shore and Rockwell tests are in extensive use and are employed according to their adaptability to the various jobs. The Brinell test is very accurate within a large range of hardness and is used on axle shafts, propeller shafts, steering arms, steering knuckles, front-axle centers, and numerous high-duty parts that are not case-hardened. This test is also used on cylinder blocks, two blocks being cut up each day and the hardness determined on the bore. Brass, bronze and aluminum castings are Brinell checked.

> By means of close inspection of all parts used in automobile assembling lines, cheaper labor may be used. Apprentices are frequently unwilling to learn trades because of the high wages obtainable in assembly work. Close-fitting parts are necessary if untrained men are used. The Buick Motor Co. averages one inspector to every 12.5 producers.

The Shore test is used mostly on casehardened parts and also on transmission gears. Piston-pins, cam-rollers, king bolts and valves are among the parts subjected to this test.

The Rockwell is in reality a modified form of Brinell test and has its own field of usefulness, being used at the present time in testing piston-rings and flywheel rings. Many parts are file-tested before grinding and are tested by the Shore method after being ground. Chassis springs are purchased under rigid specifications and are Brinell-tested at the source. Two samples of brake linings are tested on a special type accelerated-test machine requiring the application of water for cooling.

Sheet-metal parts as a rule are given visual inspection only, surface finish being the principal point noted; some, however, such as fenders and hood stock parts, are checked with contour gages. Every sheet-metal part has a master part with which the first pieces from a run are compared and other comparisons are made from time to time.

In the forging shop, new dies for drop-forgings are carefully inspected for imperfect follow, and the like, with the well known lead test. Every hammerman is required to put his stamp on every axle, crankshaft and camshaft produced so that the part can be identified in case of defects. The shop inspector in the hammer shop notifies the foreman to stop work if the dies begin to show wear.

Camshafts, crankshafts and other parts receive subsequent and continual detail checking as they pass through the various machining, grinding and drilling operations, but before being assembled undergo a final inspection in which special gages and fixtures are used.

Some of the major checking and inspection operations are as follows:

Crankshaft. A special fixture is used to check the spacing of all pin bearings, the length of throw, the location of the keyway with respect to the throw, and to indicate all main gear and flywheel bearings. All these checks, excepting those for locating the keyway and the length of the throw, are made at one revolution of the shaft. The bearings are "miked" for size, out-of-roundness and taper, the tolerance of the taper being 0.0003 in. All oil holes are tried to make sure that they are not plugged.

AUTOMOTIVE PRODUCTION

Cylinder head. The first operation is the checking of the valve-stem guide holes. The gage is set so that each valve-stem seat is centered with the guide holes and they are held within 0.0005 in. A check is made to insure that the faces of the cylinder are parallel. The seats are checked for chatter and for clean up in the grind. The combustion-chambers are checked for diameter and for depth of face. If there is water leakage the cylinder is scrapped.

Cylinder blocks. Cylinder bores are doubly checked, first by paddle gages, then by micro-gage. The paddle gages are ground into the shape of a ball and are made in steps of 0.0005 in., giving a very sensitive "feel." The micro-gages are used not only for determining the size of bores but also on the assembling floor in selecting piston fits. The bores are held parallel and out-of-roundness and taper are held within 0.0005 in. A cylinder block is also tested for being parallel on both faces. Check is made of the holes, size of the combustion chamber and height of the block.

Table II—Inspection Hours per Unit Hour

Name of Plant	Sept. 1, 1921, to Aug. 31, 1922	Sept. 1, 1922, to Aug. 31, 1923	Sept. 1, 1923, to Aug. 31, 1924	Sept. 1, 1924, to Aug. 31, 1925
Forging	14.8	11.9	10.4	7.0
Motor	17.5	19.0	18.6	14.7
Sheet-metal	....	9.9	13.4	12.6
Transmission	9.2	8.1	11.6	12.5
Axle	12.7	12.7	14.1	13.7
Average for all plants	13.9	13.0	12.5	11.7

Pistons. The length of the piston from the hole to the top is held close and check is made for the squareness of the piston with the pin hole and for diameter, depth and size of the pin hole. The out-of-roundness of the piston is held within 0.0005 inches.

Flywheels. A special fixture is used to check the runout of all faces of the flywheel and of the starting gear, and the concentricity and backlash of the clutch teeth. Every flywheel is checked for balance and is held within ½ ounce.

Connecting rods. All connecting-rod holes are reamed and checked for size and the rods are given a general inspection. They are marked with code numbers so that defects can be traced.

Intake and exhaust manifolds. Intake- and exhaust-manifold faces are checked for parallelism with each other and with the cylinder face. Tapped holes are checked, and heater surfaces are checked 100 per cent for the angle that the surface makes with the cylinder.

Miscellaneous parts. Inspection of all small parts is made under a magnifying glass, to detect defects that may not be visible to the naked eye. Camrollers are held to a runout limit of 0.001 in. and the out-of-roundness to 0.0002 inches.

In the water-pump coupling, a check is made of the diameter of holes and of the size and location of the lugs, as regards their being central with the holes.

Timing gears are checked for runout and for the size of holes with a master gear. Great care is taken to have the pitch diameter correct and to see that the gears have a backlash between 0.0002 and 0.0003 inches.

Camshafts. Camshafts are checked for the size of the bearings and of the cams. The pitch diameter of the oil-pump driving gear is important. The bearings must run true; if they do not they will soon "wipe" out the cam bushing. A special fixture is used for checking the shape and location of cams with the keyway and the runout of the cams.

Delco equipment. Although the Delco units are given very thorough inspection by the maker they are given additional inspection as a further precaution against unsatisfactory performance. The first operation is the checking of the diameter of the pilot on the generator end of the frame; this must be within 0.0005 inches. The coils and the distributor assembly are checked for breakage in shipment. The end play of the armature, when the driving gear is in place, must lie between 0.004 and 0.008 inches.

The generators are then placed on an inspection fixture and are driven by an adjustable-speed alternating-current motor. Operation of the cut-out relay is checked for both the cutting out and the cutting in of the battery circuit.

Starting motors. No regular inspection is made of the starting motor. All units that do not perform properly either during the block test, the silent test, or while being assembled, are removed and repaired. A resident representative of the manufacturer is present to care for all defects for which the vendor is responsible, and also to provide a stock of service parts.

Assembling line. In the assembling line, every fourth or fifth man inspects the work of those who have preceded him. Camshafts are selected according to the size necessary to fit the bearings properly. At the end of the the line three men continually check motors for bearing fit and piston fit, to ensure that nothing has been overlooked.

Final motor inspection. During the final motor inspection special attention is paid to gear noise and to the lashing of the motor. The inspection is visual, its object being to note any minor defects that may have been overlooked. During this test the motors are run on city gas instead of gasoline.

Transmission splined shaft. When the lathe work upon the splined shaft has been completed previous to heat-treating, the inspector, using Johansson adjustable limit gages, checks all the diameters that are to be ground, including about 0.02 in. of additional metal usually left for grinding. The same inspector uses a profile gage that hooks over one end of the shaft and gives the dimensions between all faces and shoulders, which at this time are held by visual inspection to

Table III—Budget for Week Ending Aug. 8, 1925

Name of Plant	Ratio Allowed, Hours	Running Ratio Hours for Week Ending Aug. 8	Running Ratio Hour for Year Sept. 1 to Aug. 31, 1924
Motor	10.0	9.8	10.1
Axle	12.1	15.0	12.6
Transmission	12.0	12.8	12.1
Gray Iron Foundry	34.0	35.0	32.6
Brass & Aluminum Foundry	28.0	....	21.0

AUTOMOTIVE PRODUCTION

within 0.0005 in. The spline being only rough cut is not inspected until after the operation has been finished.

When it comes from the heat-treating department, the shaft is delivered to the grinding department, where one particular diameter is ground within 0.0005 in. and four other diameters between 0.001 and 0.002 in. Each of these diameters is then inspected with Johansson gages, as well as with several other special gages.

Additional inspection is given by means of a heavy block gage having two parallel plates between which the shaft is passed to ensure that the surfaces of the spline are parallel with the center line and with each other to within 0.001 inch.

The length of the shaft, previously gaged visually with a profile gage to within 0.0005 in., is now checked in the following manner. A fixture having a heavy gray-iron base receives the shaft in a vertical position and the 0.0005 limit bearing is inserted into the bushing. As the bearing thrust shoulder seats against the bushing when the shaft is in place, a hinge plate is lowered on the opposite end of the shaft, which must register within 0.0005 in. limits on the hardened flush pin.

The root diameter of the splined shaft is finished in the hobbing operation and is held to a limit of 0.001 in. It is checked by means of splined ring gages in which ample clearance has been allowed for all splines so that the only point of contact that the gage makes is at the root of the shaft. The pitch diameters of the splines are then checked by go and no-go splined ring gages that cover the form of the spline as well as the diameter of the fixture.

Transmission counter three-gear forging. This gear, being one of the most important in the train of gears in the transmission, receives 100 per cent inspection of all the following operations:

The first inspector is located between the automatic lathe department and the Fellows gear shaper department. He places the gear vertically upon a stub arbor and drops a ring gage over the end of the arbor, which protrudes through the gear and has flush pin limits. This checks the overall length, which is held within 0.005 inches.

After the gear has been removed from the arbor, a male block gage, which also serves as an arbor is inserted into the same hole. This arbor or block gage is then inserted within the centers of a Brown & Sharpe indicating center where all three gear blocks are indicated for eccentricity, the allowable limit of which on the outside diameter of any of the three blocks is 0.004 inches.

The side faces of the gear blanks are held to a maximum eccentricity of 0.002 in. Profile gages locate each blank upon the barrel, as well as the undercut chambers and spacing.

After the gear has passed through the teeth-cutting operations, an inspector places it upon specially constructed indicating stanchions where the pitch diameter is checked for eccentricity by rolling the gear against hardened master gears. During this operation the inspector, while rolling the gears with his hands, leans the weight of his body against an extended arm that carries a movable center, and applies the desired amount of pressure at the contact point.

Any teeth that may be high or low or that have been burned by the cutter are instantly indicated on an Ames tooth-indicator. The maximum of eccentricity allowed on any of the three blanks is 0.003 inches.

Another inspector then measures the pitch diameter of each blank by using two 0.25-in. hardened pieces of rod, drilled through their centers to permit their being fastened to the ends of a piece of piano wire. The piano wire resembles a horseshoe in shape with a hardened pin attached to each end. The tension of the piano wire holds the wire between the teeth of the gear while the inspector with a micrometer measures the distance over each pin as the pin rests upon the pitch diameter.

The gear is then heat-treated and hardened, after which a flanged bronze bushing is assembled at either end, and an inspector checks the overall length of the gear from the finished faces of the bushing.

The pilot, on which the fourth gear is mounted, is indicated between horizontal centers, to ensure that the fourth gear will run through with the three gears that are integral with one another.

If the pilot is found to be 0.002 in. eccentric, a chalk mark is placed on the low side and this side is assembled with the high side of a fourth gear that has been correspondingly marked before being assembled.

All materials and finished parts in the Buick plant are thoroughly inspected for chemical and physical properties in the case of materials, and for accuracy in the case of parts. The Brinell, Shore and Rockwell tests are used extensively for this work according to their adaptability to the various jobs. The detailed checking for the parts is described.

Transmission case. The first inspector that handles the transmission case receives it when only the bell or flange end has been completely machined. The vertical standard for the 3.5-in. vertical arbor is used by slipping the case over the arbor, giving practically a ring fit. The end of the arbor is bored to receive an indicating arm that carries two Ames indicators. The maximum amounts of eccentricity allowed are 0.005 and 0.007 in. for the face of the flange and of the pilot.

The next inspector receives the case at the foot of a conveyor after the case has been completely finished. Here a block gage checks each of the reamed holes.

Differential carriers. First the holes are inspected with go and no-go gages, then are checked the depth of the sleeve bearing, the diameter of the counterbore, the location of the faces with respect to the lugs, the ring diameters, the clearance for the housing, and the flush-pin depth from the pinion to the face of the carrier.

In determining the alignment of the differential bearing with the pinion bearing a special fixture is used.

AUTOMOTIVE PRODUCTION

In I-beams, the inspection covers the size of the king-bolt holes, the parallelism of the spring pads, the relation of the lock-bolt holes in the king bolt holes, and the length and squareness of the latter. Clip holes are checked with a template.

Main shafts are checked for length, width of keyway, spline and taper.

The roll of the pinion shaft is determined for trueness and the length of the shaft, the taper, the width and depth of the keyway, and the spline are inspected. Diameters of the bearings are held within 0.0005 inches.

The fixture for testing 14-in. steel flywheel rings is composed of three parts: a base, a sub-base, and an expanding top, consisting of twelve segments or movable parts dovetailed on the lower side to fit into other dovetails in the sub-base. Only six dovetails are cut in the sub-base, the remaining six being held in place by cap screws to take up wear. In each segment a slot is milled to accommodate a spring that holds the segment against the expander, which is dodecagonal in shape, tapered, and is pulled down by a connecting rod and cam on a shaft operated from one side of the fixture.

As the expander has twelve sides, the same number as that of the segments, and both have the same taper, a true bearing on the segments is obtained at all places where expansion takes place and the fixture has a perfect outside diameter.

A two-to-one ratio lever is fastened to the base of the fixture, the short arm resting on the segment, the long arm operating an indicator that gives exact readings in thousandths of an inch.

The indicator is adjusted for a steel ring approximately 14 in. in diameter, but the segments have steps of different radii to accommodate rings of different sizes.

Sheet-Steel Fabrication

By Syd Smith
Studebaker Corporation of America

WE ARE living in an era of competition in the construction of automobiles. During the next few years we shall probably experience considerable tension in this direction and the industry will be reduced to a "survival of the fittest." Our best efforts therefore should be directed toward producing parts by the most economical methods possible. Inasmuch as from 25 to 30 per cent of the weight of an average passenger car is due to the sheet or strip steel used in its construction, and as the general appearance of a car is dependent mainly upon this fabricated metal, the duty of men in our profession with regard to reducing the cost of the material used in construction cannot be exaggerated.

The greatest possibility for improvement, in my opinion, lies in the conservation of stock, because approximately 65 per cent of the cost of a piece is in the stock, the remainder being labor and overhead expenses. With this point in mind, about a year ago we began making scale drawings of each size of sheet steel received at our factory, to show how scrap from the large pieces could be used to the best advantage in producing small parts.

After this practice had been in progress for a few months, we learned that in the average production of one month we had saved a little more than $8,000, whereas the salary of the layout man was only $200. A card-index file arranged with reference to gages of stock informs us quickly whether it is possible to make a new piece from scrap material.

In a body plant, the ratio of the small automobile parts that can be made from scrap to the larger ones is such that even though they all were made from scrap, a surplus would still remain. With a view to conserving every part of this material in the same manner that a meat-packing company utilizes all the parts of a hog, we are now endeavoring, by welding together small pieces, to make from No. 16 to No. 22 gage scrap such regular sized and shaped sheets of stock as would be suitable for parts such as dust pans, seat pans, regulator boards and the like.

The regular blanking and minor forming operations can be performed after welding. The opportunity for economy along this line is very great; and manufacturers of equipment suitable for this kind of work should develop means for automatically feeding stock through welding machines or welding it without feeding.

Within the last few years, wonderful progress has been made in the production of parts from sheet or strip steel that used to be made from castings and forgings, particularly body parts. Still greater possibilities exist along these lines even to the extent of making phaeton tops from a single sheet of welded steel. Such a top would cost about 60 per cent as much as do the present fabric tops, would last as long as the body and would look better at all times. Sounds produced by vibration can be prevented and stiffness and similar qualities can be provided for by proper shaping and reinforcing. I mention this item merely as offering food for thought.

The average cost of the finished sheet-metal parts of an automobile, including the enameling of the various parts, is about $0.075 per pound. This is about equal to that of iron castings, one-half that of malleables, about 30 per cent less than that of forgings and only about one-tenth that of aluminum castings. Although sheet-metal parts are about equal to iron castings when compared on the basis of cost per pound, they would make an even better showing on a basis of strength cost.

This shows why the trend has been and will continue to be toward stampings and away from castings and forgings. Until a few years ago, stampings were considered to be of second- or third-rate importance and reecived attention from the heads of technical departments in this proportion. Instead of being routed and processed like their cousins, they were left to find their

AUTOMOTIVE PRODUCTION

own way through the plant. But today conditions have changed, as will be evident from some of the accompanying illustrations.

In order to cite a concrete example and to show a method of producing sheet-metal parts, such as is typical of those in use in the plant of the Studebaker Corporation, the progress of two automobile parts, the shroud and the tonneau will be followed during their fabrication and the manner of assembling the side-rails and some minor parts into the chassis frame, will be described.

In the fabrication of the shroud, the stock is first trimmed by a rotary shear into regular blanks, which are then run between rollers to remove stretcher strains. In the next operation hydraulic presses draw the blanks into the form of a half shroud. The surplus metal is then trimmed off, the corners are notched with a band-saw, nail holes are pierced, and patches are put in to fill up the notches left at the corners of the blank. The patches are welded into place with an oxy-acetylene flame and, after the welding operation, the surplus steel is ground off.

The two shroud halves are then butt-welded together. The ventilator lid opening is punched in and formed by bending down the edges, the reinforcement band for supporting the instrument board is spot-welded to the shroud as is also the dash. Holes for lacing are pierced and counter-pierced at the same time, notches on the inside of the jig indicating to the operator the points at which the holes are to be punched. The outside of the shroud is then bumped and finished, and is inspected for both dimensions and finish.

The forming and trimming of the back panel are performed in a manner similar to that of the shroud. It is trimmed and gaged to fit together with the side panels. The flange is made by sawing to a pattern and is then formed and trimmed. The two side panels go through the same process, are sawed to a pattern to match the back panel and all three are welded into one unit. Our variety of current bodies is so great that it makes the use of trimming and blanking dies prohibitive on large panels.

Holes for the fender bolts in the wheel housing are drilled in the side panels before they are welded to the back panel. The accuracy of manufacture of the panels and sub-assemblies is maintained throughout the plant, to insure their snapping into place on the body frames on the assembling lines without any additional fittings.

Into all panel assemblies is set a corner piece, the function of which is to space the panels to the proper width and to prevent them from spreading. Strengthening pieces are put into both the upper and lower corners of the weld.

At the present time, panels for 600 jobs per day are being finished in this department. As soon as they are finished they are put into stock and lined up for use on the assembling line. While being assembled, the bodies are mounted on a special jig by means of which they can readily be turned upside down during the paneling operation.

A very important point in the assembling of the panels is the interchangeability of the doors; putting on the doors was formerly a high-priced operation and the work was slow. Now the doors can be put on quickly by common labor and all fit perfectly without adjustment.

After the bodies come from the assembling line, they are treated with Deoxidine, washed with an alkaline solution and rinsed with hot water preparatory to enameling. They are then sent through a drying oven to remove all moisture from the panels and the frames, and are tackragged to remove all dust that may have been collected during the process.

After the first coat of enamel has been flowed on, the body is allowed to drip for 20 min., then is baked for 1 hr. 15 min. at a temperature of 350 deg. F. Two succeeding coats of enamel are applied in the same manner.

When the bodies start down the line, handles are put on the doors, holes are reamed for the windsield, the various trimming operations are performed, the top is built on and it is now ready for the final assembling line.

The preparation of panels for our closed bodies is similar to that for the open bodies, so the details will be omitted.

In a Standard Six Coach tonneau the sequence of assembling operations is as follows:

1. Assembling of rear pillar panels.
2. Assembling of back panel, in one piece.
3. Assembling of front pillar panel.
4. Assembling of coupe pillar panel.
5. Assembling of shroud cross-bar panel.
6. Assembling of shroud.
7. Assembling of door-sill panel.
8. Nailing bottom flanges.
9. Assembling molding.
10. Hanging doors.

> The struggle for existence which the automobile manufacturer is bound to face in the ever increasing competition, makes it necessary to use the most economical methods possible in production. The men who handle the sheet-steel work find the greatest opportunity for cutting expenditures in the careful laying out of the pieces on the sheet-steel stock.

By means of a revolving fixture the body is turned over and all panels are nailed to the frame-bottom sills. Door panels are laid in the frame, another wood frame is placed upon them and pressure is applied through the clamps while they are being nailed.

Next, holes are drilled and the hinges are put on. No wood is exposed in its natural condition. The frame is then turned upside down and the regulator board and lock board are put on. When the finishers have removed whatever scratches remain on the panel, it is ready to be hung on the car.

From this point the body goes through the various minor operations such as removing the small imperfec-

AUTOMOTIVE PRODUCTION

tions and the like, after which it is cleaned in a manner similar to that of open bodies preparatory to lacquering and trimming. It is one of the general principles of the Studebaker Corporation of America to admonish employees throughout the plant that the materials they are handling are valuable, consisting largely of highly finished sheets, and they are requested to use care in handling them so that scratches, dents, slug marks and the like, shall be avoided, for such imperfections increase the cost of the finishing operation and sometimes produce a total loss of the part.

Incidentally, the production of each day is represented on a wall chart by the length of red chalk lines, the aggregate length of which represents the monthly quota. In this way employees can readily see just how many parts are needed to complete the month's output. Throughout the plant, method of operation and quality are considered more important than tools and quantity.

Sheet-steel products are rapidly replacing the forged parts to which they were formerly merely supplemental. They have proved to be more economical and superior in strength and lightness. Because of this superiority they are coming into their own and are now systematically processed where once they found their own way through the shop

The foregoing covers the fabrication and assembling of some of our light sheet-metal parts, and we will now take the chassis frame as an example of our practice in fabricating and assembling heavier stampings.

Steel for the frames is unloaded from cars at one side of the shop and from that point passes continuously through the various processes until it finally reaches the final assembling line. There is no back-tracking.

Specifications under which the steel is purchased cover both its physical and chemical properties, including drawing quality, dimensions and gage.

Samples from each shipment received are taken by the inspection department and undergo thorough laboratory tests, the steel meanwhile being held in stock until it is released by the laboratory.

The first operation on the side-rails is to blank and pierce them at the same time. The same blank is used on both sides of the frame.

The second operation is to form on the same press used for blanking. From 6,000 to 8,000 rails are blanked in each set-up before forming. Scrap from the blanking operations is passed immediately from the press to the shears to be cut up into usable sections. These are used later for gussets, cross-members and the like.

Due to the fact that we pierce before forming, it is necessary to keep a close check on all holes to insure their proper relation to other parts on the assembling line. At this point, the blanks are put into steel racks which can be piled ten high.

The next series of operations is the assembling of the spring-hanger castings, for which hot rivets and pneumatic squeezers are used.

From this operation the rails pass to a pneumatic assembling fixture that assembles them with the cross members and gussets that have previously been made up into small assembling units. These subassemblies include the front- and rear-torque cross tubes, the subframe assembly, and the brake-shaft cross-member assembly.

After the cross tube has been squeezed into the rail, it is expanded by a tapered plug and is riveted permanently into place. The frame being now completely assembled but not riveted, is placed in a revolving cradle that holds all the members in their correct relative positions. These cradles are on an endless conveyor.

This revolving fixture makes it possible to rivet the frame from both sides, while at the same time insuring that the frame will have the proper dimensions after riveting.

As the frame passes along the line, the riveting is performed by groups, each of which is composed of three men, a hammerman, a sticker and a bucker. Each gang is responsible for a certain number of rivets, and the entire frame is inspected afterward to make sure that no rivets have been left out or are loose.

The next operation in the frame assembling line is the drilling of the body bolt and the motor bolt holes in one jig, to insure the correct relative position of the holes in the chassis. After the drilling of these holes, the jig is lifted from the frame by an electric hoist and is placed on the following frame. Hot rivets are used throughout and produce tight joints with no fractures in the frame around the rivet holes. The present capacity of the frame assembling conveyor as now operated is 45 frames per hour.

When the frame has been completed it is transferred to a hot bath for cleaning prior to enameling. The conveyor that carries the frame through the bath is part of an endless system that conducts it through a continuously operating oven, in which the frame receives two coats of enamel and is baked at a temperature of 300 deg. F. after each dipping. After emerging from the enameling oven, the frames are automatically released from the carrier and slide down a chute to receive minor assembling operations.

First, a ground wire is installed for the battery, and felts are put on for the motor and the motor dust-pan. Then, in turn, are added the running-board brackets, the brake cross-shaft assembly, and the steering-gear bracket. The frame is now ready for the final assembling line.

In conclusion we will say that practically all our dies are designed and built in our own shops, the steel sections of all forming dies being shaped on Keller toolroom milling machines.

All blanking and trimming dies and almost all forming dies are equipped with hardened and ground steel liner pins and bushings. The shanks are of steel and are inserted with the shoulder at the bottom to prevent their pulling out.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Convenient Profiling Fixture

By I. B. Rich

For finishing the outsides of instrument covers or other pieces, profiling is such a convenient method that its use is increasing in many shops. The Pioneer Instrument Co., Brooklyn, N. Y., uses this method very largely in finishing the outsides of instrument cases, where lightness and appearance are two important factors. Such a case is shown in Fig. 1 with two parts in front of the fixture and a cover in position in the fixture.

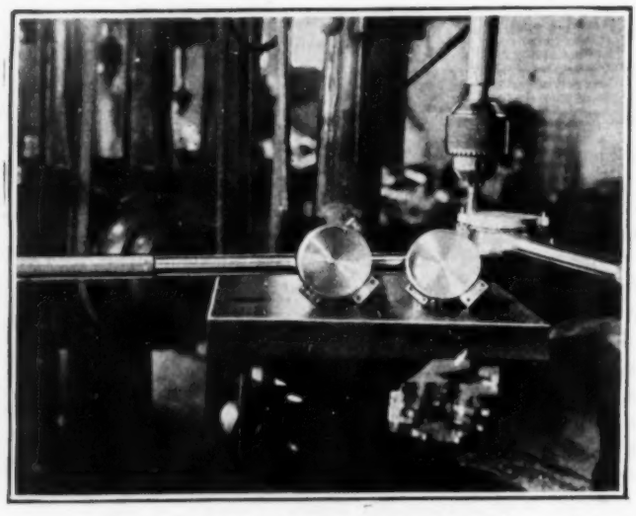


Fig. 1—Profiling fixture and work

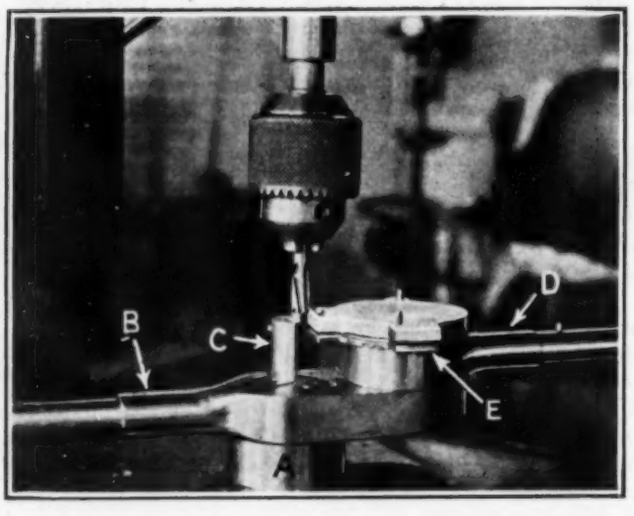


Fig. 2—Details of the fixture and former

A closer view in Fig. 2, shows the details of construction clearly enough to allow any one to modify it for his particular needs. The base *A* is fastened to the table of the drilling machine and on it the lever *B* is mounted, using a substantial bearing to insure steadiness. The movement of the lever is limited by the stop *C*.

On the rear end of lever *B* is mounted another lever *D* which has a substantial bearing and carries both the hardened-steel former *E* and the work to be profiled. The end of the milling cutter carries a guide of the same diameter as the cutter, the guide making contact with the former when the work has been milled to size and allowing the cutter to follow the proper contour, without going beyond the proper depth.

The combination of the two levers, one being controlled by each hand, as seen in Fig. 1, provides for a universal motion. In operation, the work is kept against the cutter by pressure exerted on the lever *B*, and is fed past the cutter by movement of the lever *D*. By changing the former plate, which also acts to hold the work, any desired form can be followed and the work turned out about as fast as the operator can cause it follow the form. The device is not expensive and it can be used to advantage even where a comparatively small number of pieces are to be made.

Compensating Chuck Jaws—Discussion

By H. Maplethorpe
West Bromwich, England

In an article under the title given above, and published on page 629, Vol. 62, of the *American Machinist*, Arthur Sylvester said: "A three-jawed chuck is one of the most difficult things to keep true, especially if it is used by more than one person." I am quite in agreement with Mr. Sylvester's statement.

While there are many mishaps that will cause a chuck to be damaged, I have found it is very rare that the jaws themselves are out of true, but invariably the trouble is in the scroll plate. Therefore, to true up the jaws as described by Mr. Sylvester, will result in their being true only in the position where they were ground, and if opened or closed to grip work of varying diameter, they will not be true.

I have tried many ways to true up chuck jaws so that they would be true at all positions, but have never succeeded. The only remedy is to put in a new scroll plate.

IDEAS FROM PRACTICAL MEN

Milling and Boring Fixtures for Printing Presses

By R. E. Marks

The advantages of using fixtures in printing press work is well known to the builders but, unfortunately, many do not build presses in sufficient quantities to warrant heavy fixture expense. One exception is the Kelly Press Division of the American Type Founders Co., Elizabeth, N. J., where fixtures are used to a great extent, and are made possible and profitable by the quantities of presses built in each lot. Some of the fixtures are shown herewith.

One large fixture used in milling a bed or frame is shown in Fig. 1, the fixture being fully as large as the

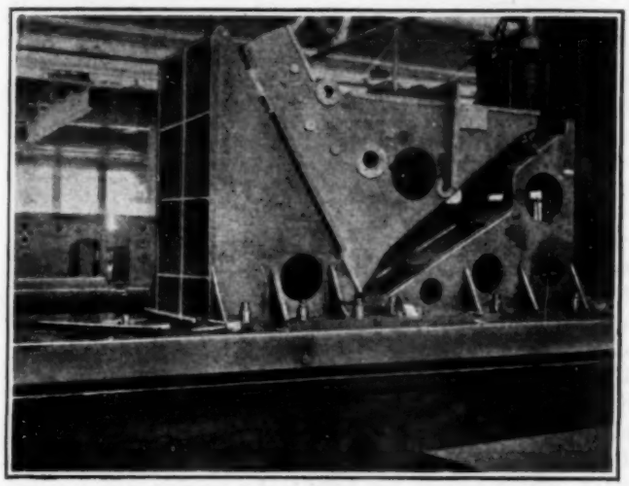


Fig. 1—Fixture for milling frame

work itself. The frame would be a very awkward piece to hold without some such fixture and much time would be required to line it up properly for milling. With the fixture shown, however, it is an easy matter to put the frame in place, adjustment being secured by small jack-screws. A large square is used to test the squareness of the milled surface with the bosses.

Two views of one of the large boring fixtures are

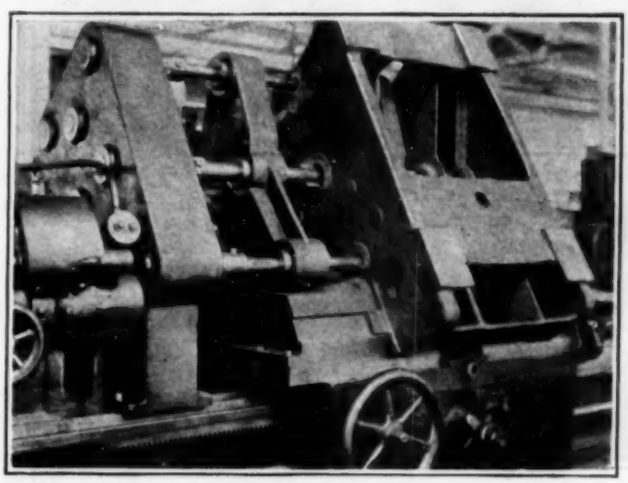


Fig. 2—Driving end of boring fixture

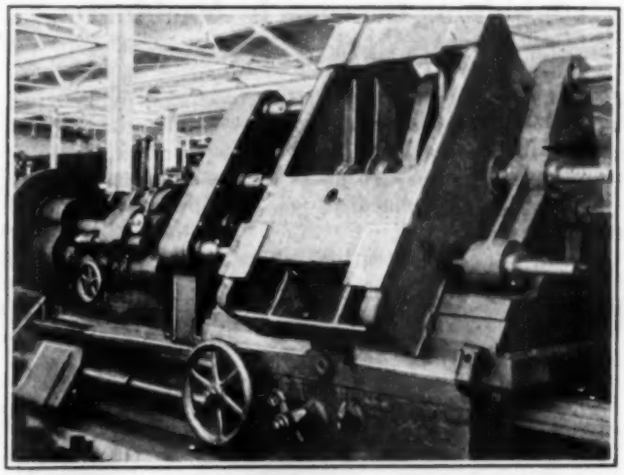


Fig. 3—Boring fixture and lathe

shown in Figs. 2 and 3. The fixture is mounted on the carriage of a heavy lathe. The base of the fixture is made very heavy to insure against springing when the frame is in place. Fig. 2 shows the driving head, taking its power from the lathe spindle and having separate spindles at fixed center distances for each hole to be bored. The bars and cutters are also shown, together with the push button control that is conveniently located.

A more general view of the fixture and the lathe itself, is shown in Fig. 3. This view also shows the

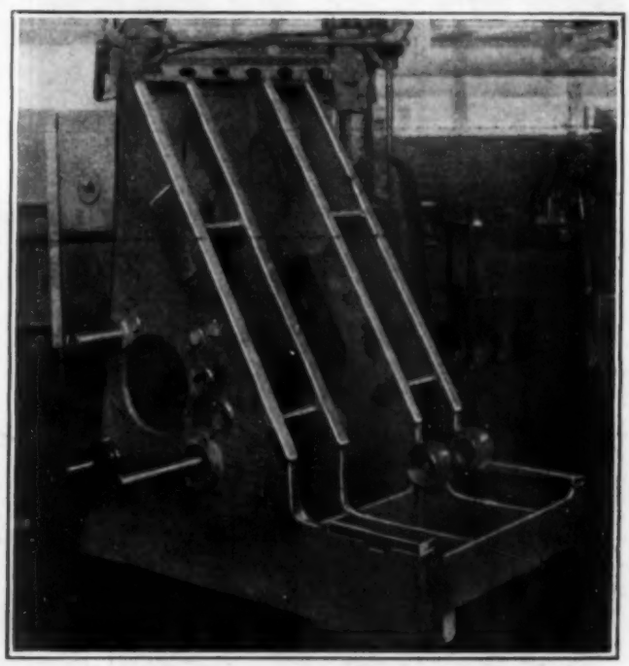


Fig. 4—Frame being inspected

central support for the boring bars, and the substantial manner in which the bars are supported.

In Fig. 4 is a view of the frame after all machining has been done. It shows the shape of the piece and the various machined surfaces. The frame is being inspected for sizes and alignment of holes, and the test bars are shown in place.

IDEAS FROM PRACTICAL MEN

Babbitting Bearings by Machinery

BY CHESTER H. FRANKLIN

The old methods of babbitting bearings, by pouring the melted metal into a mold by hand and perhaps peening it afterward, has given way to machine molding, where bearings are made in any quantities. Nor is this practice confined to small bearings, as can be seen by the illustrations.

The first two illustrations show the method of the Cleveland Automobile Co. in babbitting connecting rods, two rods being handled at one operation. The work is done in a special die-casting machine in which the rods are clamped in position and the metal forced in place under pressure. Fig. 1 shows the rods in place, and Fig. 2 shows them with the bearings cast. The sprues can be seen on both rods.

A machine for babbitting very much larger bearings is shown in Fig. 3, and is in use in the shop of Fairbanks, Morse & Co., Beloit, Wis., for casting bearings for large Diesel engines. The principle is the same in both cases, but the machines are quite different in design, as can be seen.

Fig. 3—Machine for casting large bearings

A "Putting On" Tool—Discussion

BY CHAS. DOESCHER

In an article under the title given above, on page 1012, Vol. 62, of the *American Machinist*, Geo. McCadden tells how he made use of a "putting on" tool to save a bushing that he had bored large, by heating and then shrinking the hole by spinning the bushing on a rod, while being partly immersed in water.

There is another way to shrink the hole in a bushing with less effort, and which will at the same time make the hole smaller than the method described by Mr. McCadden. It is done in the following manner: The bushing, when heated, is placed on a short pine board and lowered into a tank of water to a depth that will allow the water to come almost flush with the top of the bushing, and is held in this position until the bushing becomes cold. By this method, the entire outside of the heated bushing is completely surrounded by water, which causes the hole to be quickly and evenly shrunk. The only precaution necessary, is to keep the water from going over the bushing and into the hole.

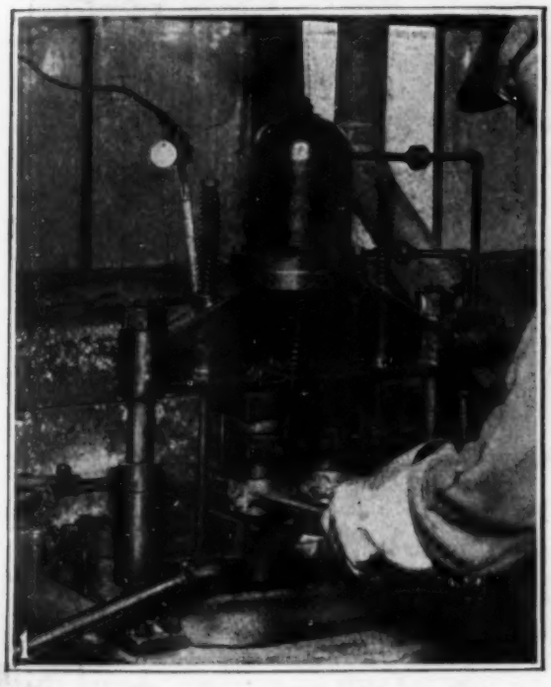


Fig. 1—Casting two connecting-rod bearings at once.

Fig. 2—As the rods come from the casting machine

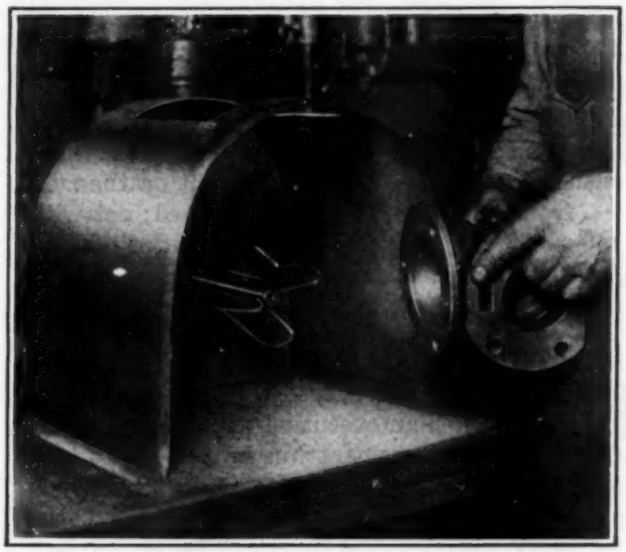
IDEAS FROM PRACTICAL MEN

Removing Burrs with an Egg Beater

By Henry C. Francis

A method of removing the burr that is thrown up in boring a hole in cast iron, is shown herewith. It was devised by one of the employees of the Westinghouse Air Brake Co., Wilmerding, Pa., for burring the ends of the triple-valve bodies, as shown.

The device is simplicity itself, being a revolving head in which are inserted four flat brass wires, bent into about the same shape that we find in the kitchen



An egg beater for removing burrs

egg-beater. The wires revolve at fairly high speed and the operator simply pushes the valve body over their outer ends as they revolve. The result is that the burr is removed about as fast as the valves can be handled.

Saving Welding Rod—Discussion

By A. R. Luechinger

On page 969, Vol. 62, of the *American Machinist*, there was published an article by L. D. Case, under the title given above.

While the method described by Mr. Case undoubtedly saves the ends of welding rods, does it save time and money? Assuming that Mr. Case had reference to rods, used in arc welding, a saving of three rods per man per day would amount to about four cents, taking rods at twelve cents per pound. This four cents must pay for the time required to make an average of twenty-one welds, in order to save waste ends to the equivalent of three rods. In other words, the welder's time and energy is wasted in saving these pieces of scrap, when it might well be used to better advantage in production work.

In actual production-welding by the electric-arc method, the waste ends should not exceed 1½ in. in length on electrodes of ⅛ in. in diameter. Regardless of what method is used to endeavor to save this waste, it will be found to take more time than it is worth.

The paying time in welding, is the time that is actually spent in depositing metal in the weld. Therefore, the time spent in taking up and inserting new rods in the holder is waste time, and should be held down to a minimum. Stressing this fact in instructing welders, will certainly be more apt to be profitable, rather than teaching them how to save ends.

With rods used in oxyacetylene welding, it is also well to use discretion as to when it is cheaper to discard ends, rather than to weld them to new rods. The ends of tobin bronze, german silver or other comparatively expensive rods of fair sized diameter, can be saved, but even then it is a question if the time and gas consumed is worth the effort.

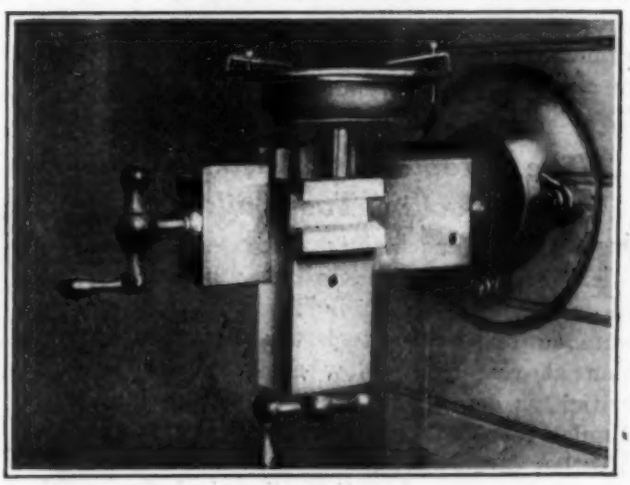
From personal experience, I have found that instructing welders to use the rods until they are as short as is consistent with good welding practice, is about as far as it is practical to go.

Test Stand for Surveying Instruments

Herbert F. Crawford

The usual method of testing surveying instruments is to mount them on a tripod and level them as is done on the field. This means more or less delay in getting them level.

Brandis & Sons, Brooklyn, N. Y., have a very convenient method of testing transits and is one that eliminates much of the time necessary by the old method. A sliderest is mounted on a base that resembles the swivel base for a vise. The base is fastened to the wall so that one slide of the sliderest is horizontal and the other vertical. The vertical slide carries a base to which the transits can easily be clamped so that they can be mounted and located in minimum time.



Test stand for transits

The two slides afford adjustment both as to position and height, and the device saves many hours in testing transit adjustments.

It will be noted that the base of the stand has been completely isolated from the rest of the siding by the channel that surrounds it. The base is bolted through the wood to a masonry column and the channel prevents any change in the wood, due to atmospheric conditions, from affecting the alignment of the test stand.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

The Steel Treaters' Exposition

ONLY a few years ago there was no steel treaters' exposition. Last week there was shown in Cleveland what many machine tool builders termed the best exposition of machine tools ever held. Due praise to the American Society for Steel Treating, under whose management the show was staged.

One reason for the success of the "Steel Show" is the policy of showing equipment in operation. A machine going through its work is comparable to a horse going through its paces. No successful horse show ever exhibited its horses standing only. A machine tool taking a hogging cut or turning out profit-making parts at high rate, creates much more desire for ownership than does one that is just standing.

Worth-while inquiries were plentiful at the steel show. Sales were made, not only of machine tools, but of heat-treating, inspection and other equipment. These results were gratifying. But there was another result that in the long run may mean more than either immediate sales or prospects. It was the educational value of the exhibits. Of the 40,000 who attended there must have been many who went back to office or shop with eyes open as to the possibilities of modern equipment and with the conviction that they cannot afford to try to do business with obsolete machines and tools.

The Automobile Industry and the Machine Tool Builder

THE various points discussed in the first articles in this issue bring to a focus many ideas that prevail in industries that use large numbers of machine tools to secure mass production at remarkably low costs. For while the criticisms come from the automotive industries, similar ideas are expressed in production offices of other large plants.

The points under discussion include, on the surface, problems of design, workmanship, lubrication, repairs, and salesmanship. In reality they include the more vital question of business ethics as well, and this, as is pointed out, affects the whole problem very seriously. It is not to be supposed that all the infractions are on one side. The seller may be just as guilty as the buyer and with less excuse. And instead of one blaming the other, both should be able to see that both industries will benefit by laying the cards on the table, face up, and playing the game fairly.

It is extremely difficult for the production man in an automobile plant to appreciate the problem of the machine tool builder, owing to the great difference in output. The production of machine tools is, and must be, small as compared to that of automobiles. In some cases the total possible market for a machine may not be over a hundred; not enough to pay for designing and developing charges unless what seems to be an exhorbitant price can be secured. This condition must be considered by the man who desires such a machine.

The only way in which either industry can profit to the fullest extent is by understanding the other's problems and co-operating as fully as possible. It is in the hope of pointing out the need for this understanding and co-operation that these articles are presented. Further light on the subject, from both sides, will be welcomed; not with a view of prolonging a controversy, but of making it easier for both sides to get together.

Teamwork

HAVE you ever wondered why failure was the result when an executive with a long record of successful management was brought in to take hold of a sick company? In a majority of such cases, according to one of the leaders of the machinery industry, the trouble is caused by lack of teamwork. Somewhere down the line is a man, or a group of men, who is not doing his job either through ignorance or lack of interest or worse.

Modern industrial enterprises are so large and so complicated that it is impossible for any one individual to keep track of all the details. Under such circumstances it becomes a vital necessity for the man at the top to have men all the way down the line who know their jobs and take an interest in doing them to the best of their ability. One weak link in the personnel chain may undo much of the good work done by all the rest.

Just as in a busy production machine shop the slowest machine acts as a bottle neck and slows down the production of faster machines to its inefficient rate, so the slow man in an organization tends to retard the work of faster men who depend on him for doing a certain task. Teamwork in the factory, therefore, is just as important as it is in an athletic competition and the stakes are larger by far. It is up to the man in the ranks to do his part and up to the man in command to see that every one under him has the instruction and the encouragement he needs to make him proficient.

Shop Equipment News

Gray Openside Planer

Extreme ruggedness of construction in each detail has been combined with simplicity, convenience, accuracy and safety of operation in the design of the openside planer which is being built by the Gray Planer Co., Cincinnati, Ohio. It is now available in four sizes, 36-in., 42-in., 48-in. and 60-inch.

In the effort to develop a machine to meet the company's desire for heavy-duty performance combined with accuracy, a marked departure has been made from previous designs of similar-purpose equipment. The planer is illustrated in Fig. 1 from the operator's position.

A cross-section drawing of the bed and table taken through the center line of the bull-gear is shown in Fig. 2 to indicate the construction. The bed, in addition to its four vertical walls, is cast solid across the bottom under the gears and a heavy brace is included to run across the top directly under the cutting tools and the rail. The principal purpose of this construction is to provide sufficient stiffness to eliminate vibration. The remainder of the bed is cast solid on top. It is planed on the bottom to relieve internal casting strains and to facilitate leveling for installation.

The outer bed wall extends up on the side of the column to the level of the top of the table in order to provide support for the column high up and near to the rail. A heavy tongue and groove is planed into the bed and column to provide a solid metal contact between the two parts and to definitely locate them in relation to each other. No part of the machine extends below the flat bottom of the bed, obviating the necessity of pits of any kind in the foundation. The bed is twice the length of the table so there is no overhang at the maximum length of stroke in either direction.

The table is of box section with heavy internal walls. One of these walls, which can be seen in Fig. 2, extends the full length of the table directly under the central T-slot to tie the top and bottom plate together in order to prevent any springing.

Hold-down gibs, which run the length of the table on both sides, ride under machined shoulders on the bed and act to prevent the table from tilting at any position when the planer is used for work on heavy overhanging castings. These gibs are attached to the table by bolts which are made accessible through the openings in the side of the table so they can be disengaged for removing the table without running it off the bull-gear. Just above the gibs, the table and bed are machined on both sides to provide a substantial side-thrust bearing between them. The table rack is set into a machined recess in the bed to accurately locate it. The rack itself is cut from a steel forging.

The gear train is similar in design to the helical train that has been for some time a standard on the company's double-housing planer. The gears are cut from steel forgings. As illustrated in Fig. 3, they are helical throughout.

The bull-gear is designed to exert a side thrust on the table, due to its helical teeth, to offset the normal side pressure exerted against the table by the tools. The arrangement is said to decrease the tendency of the table to lift when a heavy cut is being taken.

To further reduce the lifting tendency, the bull-gear teeth are cut with a 9-deg. pressure angle to bring the line of forces between gear and rack to very nearly horizontal. The tooth form is also designed to provide a maximum of action in the arc of recess rather than that of approach, the form being a true involute with long-addendum pinions. This is said to have resulted in continuous rolling contact between teeth to insure a steady delivery of power for the full range of work from light finishing cuts to any heavy roughing work the machine may be required to do.

A triangular section has been adopted for the column as being best

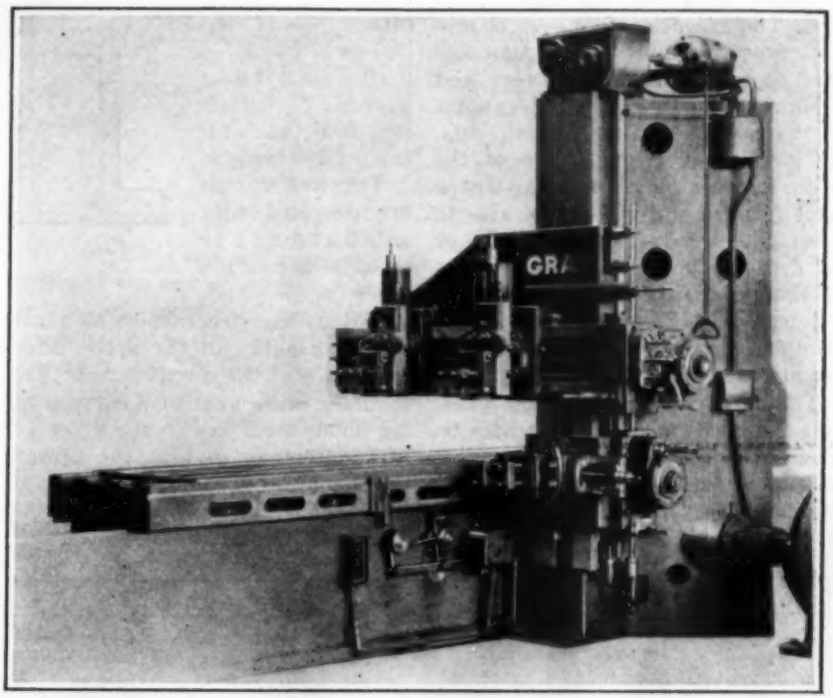


Fig. 1—Gray Openside Planer

SHOP EQUIPMENT NEWS

able to resist the severe twisting strains to which it is subjected in the openside planer. The walls are placed directly in line with the forces to be resisted, and yielding at the corners is minimized. A wide column face also provides adequate support for the side head. Inside the column, further reinforcement in the shape of heavy integral braces add to its rigidity.

From Fig. 5, a view which is taken from the outside rear of the machine, an idea of the massiveness of the knee supporting the rail can be had. It is virtually the shape of a pyramid with its base against the column. A lock secures the knee to the inside of the column in four places and the clamping effort which is automatically equalized between all of the points, is actuated by the movement of one lever at the operator's position. The exceptionally heavy clamping pressure prevents vibration and shifting between the knee and column and partly explains the ability of the machine to take heavy cuts. As a point of interest, one of the 36-in. planers was set up to cut a steel forging and was found able to operate at ⅛ in. of feed with 1 in. of cut depth without showing any signs of distress. Adjustment for wear is automatically taken care of in the clamping assembly and requires no attention.

The overhung weight of the knee, rail and heads is compensated for by means of a ball-bearing spring counterbalance developed and perfected by the company. A ball-bearing roller is mounted at the right-hand end of the rail near the top, and is forced by heavy springs to bear against the right-hand edge of the column face. It rolls on the machined surface at the side of the face as the rail is moved up or down and serves to keep the rail and knee snug against the column independent of the position of the knee clamp. The spring action offsets the overhanging weight, relieves the rail elevating screw of binding strains, eliminates cocking and possible binding of the ways, and assists in raising and lowering the rail. The dead weight of the knee and rail assembly is counterbalanced as shown in Fig. 4 by means of a weight at the rear out of the way.

On the machine illustrated there are three heads, two on the rail and one on the column. The rail heads are regular equipment. The side head is subject to specification. Each has its own quota of independent guarded controls for feed and for rapid traverse.

The tool aprons are provided with an abutment or shoulder across the lower end—standard Gray construction—which prevents springing of the apron under the strain of the clamped tool. This shoulder bears against a corresponding finished surface on the lower end of the toolbox so that the upward thrust of the cutting tools comes on the shoulder and protects the taper pin on which the apron swings.

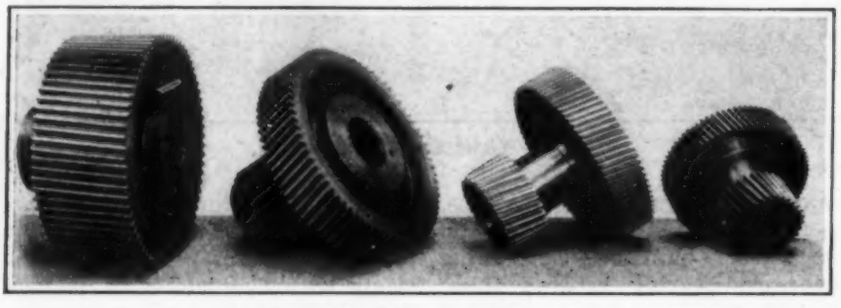


Fig. 3—The gears in the driving train

The rail can be unlocked and can then be set to any position on the column by the use of the "rail-setter" lever which hangs in a convenient position. A partial twist unlocks this lever and movement in either direction will then result in a corresponding directional movement of the rail. The mechanism is designed so that there is no rail drift when the lever is moved to the neutral position.

The company encourages the practice of using this control to within short distances from the work, to eliminate the tendency to take a long reach with the cutting tools and resulting cuts below the machine's capacity, as well as to keep the work free of chatter marks due to a needlessly long tool reach.

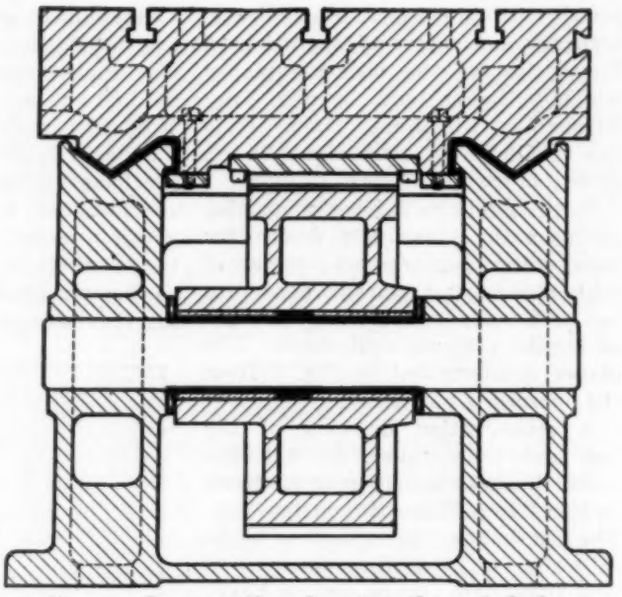


Fig. 2—Cross-section drawing through bed, table and bull-gear

A rapid-traverse lever mounted on the right-hand end of the rail is provided for use in moving the heads into place. One motion of the lever is sufficient to start the traverse motor in the correct direction, to disconnect the crank for avoiding accident and to disconnect the feed mechanism. Putting the lever back to neutral automatically re-connects the crank and the power feed again.

This arrangement makes it possible for the operator to move the tools rapidly from one section of a cut across to another and save a great deal of time that might otherwise be spent "cutting air." Either rail head can be moved along the rail without interference or similarly up and down, the rapid traverse being available if desired for the latter motion of one of the heads when the other head is at work.

Should one head be run into the

SHOP EQUIPMENT NEWS

other, or if the slide, in being moved vertically, is let go to the end of its clear travel so interference is met, a safety clutch disconnects the traholds that, with the proper oil used at the start, it need never be removed on account of this provision for clarification and cleaning. The

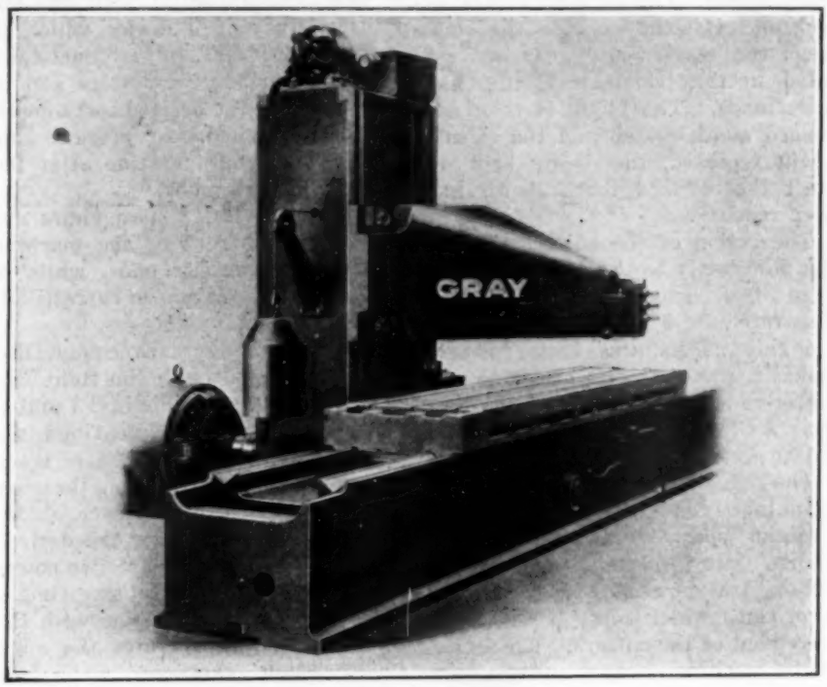


Fig. 4—A rear view showing the massive knee and column

verse motor and relieves the mechanism of all strain.

The positive feed, which is known as the "can't slip" feed since it is not transmitted through frictions, can be engaged or disengaged at the operator's position. It can be set for any desired amount up to 1 in. in steps of 0.01 in. by partially turning a control to unlock the feed dial and then turning the dial to the desired point as indicated by graduations on its surface. The same type of feed is available on the side head, which also has independent control for the rapid traverse movements.

Lubrication of the entire machine has been made as automatic and "trouble proof" as possible.

Forced lubrication is supplied by means of a pump to the bull-gear hub, the table V's, the main- and side-thrust bearings and the hold-down gibs, as shown in Fig. 2 graphically by the heavy black lines. A flood of oil is also directed over all of the driving gears. On passing from these bearings, the oil is returned through a filter and into a settling basin prior to its next journey through the machine. The company dirt picked up will accumulate in a pocket at the end of the bed, which is conveniently located for cleaning out.

Centralized oilers are provided on the rail, the heads and column, which the company recommends be filled once a week. The traverse motor and its mechanism require no attention after being once lubricated thoroughly, since the motor runs on ball bearings in grease and drives the gears, which also run on ball bearings, in a sealed oil case.

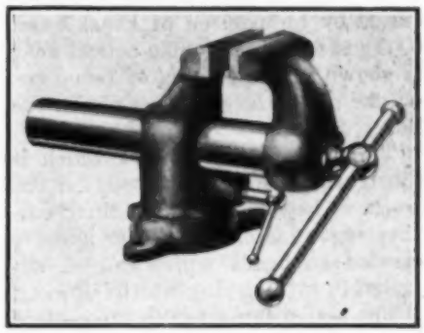
The machine can be arranged for self-contained countershaft drive, for motor drive with the motor mounted directly on the column or for reversing motor-drive.

"Dropfo" Steel Bench Vise

The "Dropfo" bench vise, which is constructed entirely of steel, is being manufactured by the Fulton Drop Forge Co., Canal Fulton, Ohio. All of the parts, with the exception of the handle, are drop forgings.

The jaw plates are forged under the hammer, and are doweled to the jaw. Their faces are knurled. Parts subject to wear, particularly these plates, can be replaced from the factory and set without any fitting, as all of the vise parts are machined to be interchangeable for each size in the line. The vise is set on a swivel base and is provided with a wedge lock which tightens automatically.

When desired, however, a station-



"Dropfo" Steel Bench Vise

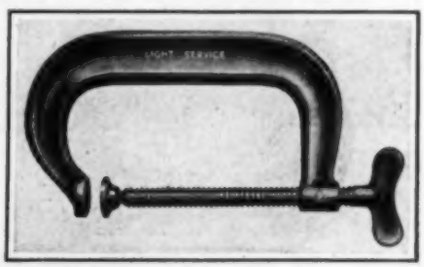
ary type can be furnished. The assembly is lighter than corresponding sizes made of cast iron.

The line comprises four sizes: 3 x 5½ in., 4 x 6 in., 5 x 8 in. and 5 x 8 in. for heavy duty.

Williams Body-Makers C-Clamps

A line of C-clamps has been brought out by J. H. Williams & Co., Buffalo, N. Y., especially designed for body-makers' service and for use in the various wood and manufacturing fields.

The clamps, drop-forged from special steel, are heat-treated to pro-



Williams Body-Makers C-Clamps

vide maximum stiffness, and the throat is of a deep design.

The screws also are drop-forged and are made in one piece, with the handle recessed and rounded to furnish a convenient grip.

The clamps are made for capacities from 4 to 10 inches.

SHOP EQUIPMENT NEWS

Sykes Double-Helical Gear Generator

The Farrel Foundry & Machine Co., Buffalo, N. Y., has developed the line of Sykes double-helical gear generators for which it has acquired the American and Canadian manufacturing rights. The machines are being built in four sizes to cover a wide range of work as can be appreciated by comparison of Figs. 1 and 5. In the latter a double-helical gear is shown in the process of being cut on one of the larger machines in the line.

Two cutters, one size of which is illustrated in Fig. 6, are used for the work. They are set with their cutting edges facing each other and are carried on heads which can be adjusted to suit varying widths of gear.

The action imparted to the cutters is a combination of reciprocation and rotation through a stroke which starts slightly outside of the end of the tooth and terminates in the center. Thus the two cutters are set at a distance apart which is slightly more than half the total blank width and are given a stroke that will bring them alternately up to cutting position and then advance them to the center where they stop, move away from the blank sufficiently to clear and return to the outer edge. The blank is set, at the start, to a desired depth of cut. The machine is started and takes this cut while, at the same time, the cutters and gear are rotated until a complete circuit has been made. The blank is then advanced another step and the circuit again repeated, this being kept up until the desired tooth depth has been reached.

The action of the cutters advancing alternately to the center and the form of the ground cutting face as illustrated in Fig. 6, which breaks the chip as soon as it is formed, makes it unnecessary to provide any center-relief or undercut at the center. As a result a continuous tooth can be formed without difficulty.

The machines can also be used to advantage for cutting gears with straight spur teeth as the only change that is necessary is to substitute straight guides for the helical form cams which control the helical movement of the cutters. The action of the machine is rapid and the gear produced, whether double-helical or spur is accurate to very close limits.

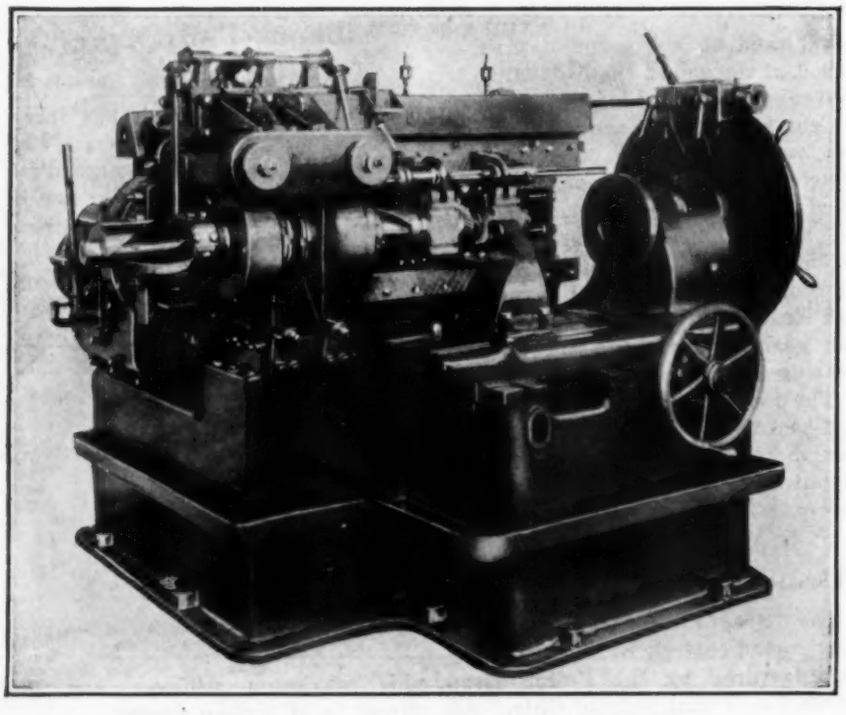


Fig. 1—Sykes Double-Helical Gear Generator, No. 1½

A number of improvements designed by W. E. Sykes have been incorporated in the construction since the machine was originally brought out in England. They are included in the smaller size illustrated and to be described in detail with one exception—that of a device which is being developed to automatically feed the work to the cutters and to shut off when the desired tooth depth has been reached. At present, this is the only hand operation after the set-up has been made.

In Figs. 1 and 2, two views are shown of the front of the machine taken from opposite ends, while in Figs. 3 and 4, are shown corresponding rear views.

A 3½-hp. motor is recommended for the drive through the tight and loose pulleys shown in Figs. 3 and 4. The shaft bears in ball bearings in a four-speed gear box which is made as a unit and mounted on the rear end of the machine. A lever, shown in Fig. 3 can be set for the desired gear selection. There are two power outlets from this gear box. One is horizontal, in front, in line with the drive shaft, and operates the main reciprocating carriage, while the other emerges vertically and terminates in a bevel gear from which the other motions of the machine are derived.

The drive to the carriage is through a bronze block which bears on vertical ways in the carriage and can be adjusted for eccentricity with the drive shaft to accommodate the varying width of work within the range of the machine. For any particular gear, the length of this stroke is a little over half of the width of face, the cut being started alternately on each side of the gear and terminated at the center as stated.

Two cutter-head bases, that carry the cutter heads on slides on their outer faces, are mounted on the main carriage and are arranged so they can be moved horizontally along its face and set in proper relation to the work by means of independent adjusting screws. Two other independent screws operate wedges behind the bases, by which they can be locked in position. The four screws are brought out to the end of the main carriage, where they can be seen in Fig. 3, and are squared on their ends for an adjusting crank.

Secured longitudinally, but free to rotate in the right-hand cutter head, is a shaft on which the right-hand

SHOP EQUIPMENT NEWS

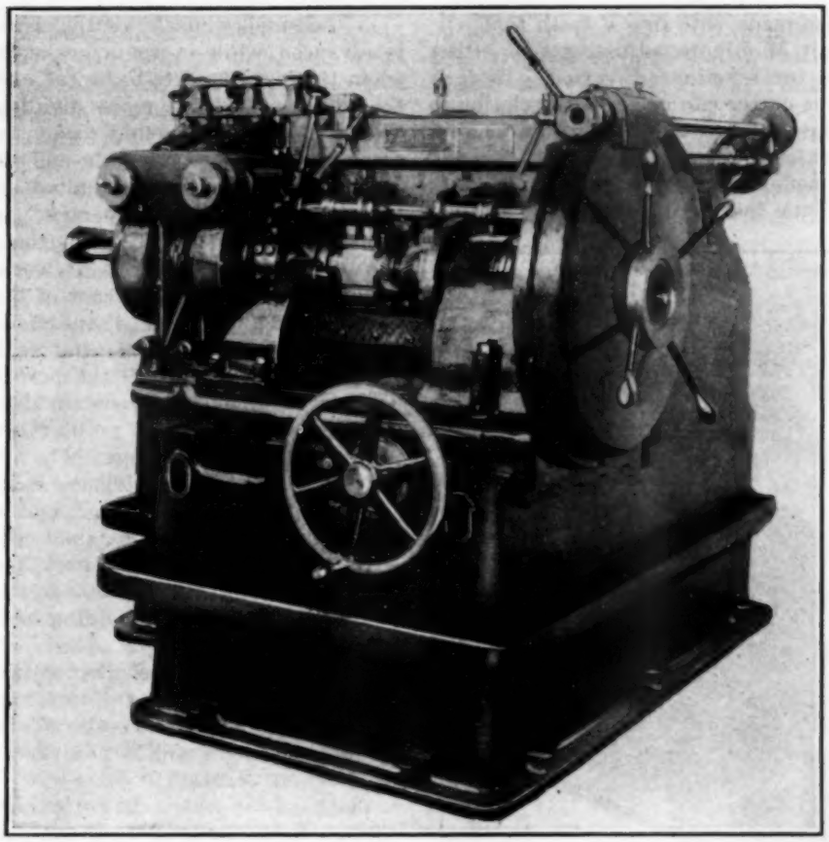


Fig. 2—A view of the same machine taken from the work-support end

cutter is mounted. This shaft extends to the left and has mounted, on its left end, a helical cylinder-type cam which is shown, at the extreme left of the stroke in Fig. 1. In the left-hand cutter head is a hollow shaft on which the second cutter is mounted and through which the right-hand cutter shaft passes with ample clearance. This hollow shaft is also without longitudinal play, but is free to rotate in the head. It terminates in another cylindrical cam which is entirely independent of the first one.

The cams ride in independent sleeves mounted in the so-called index boxes, which are shown side by side at the left in Figs. 1 and 2. Inside the sleeves are secured two-piece helical guides to match the contour of the cylinder cams. One piece is stationary, while the other is adjustable longitudinally and backs the first piece up to eliminate any lost motion.

The cams are carried back and forth in their guides with the motion of the reciprocating carriage and thereby impart the correct rotary motion to their respective cutters. The bolts which secure the guide parts and the lost-motion take-up screw can be seen on the sleeve in Fig. 1 to the left.

Each sleeve is secured to a wormwheel within its index head, which, in turn, is driven by a worm to continually rotate the entire sleeve and to thus actuate the generating motion of the cutters as they are slowly fed around. At the same time, a drive through a wormwheel mounted on the work spindle in the case at the right-hand end of the machine, rotates the work in the proper relation to the cutters. This latter worm and wormwheel assembly is known as the main dividing head.

The drive for these two motions comes from the vertical shaft in the speed box already described. A bevel gear meshes with the bevel on the end of this vertical shaft and drives through a friction clutch, which shows to the left of the bevel gear guard in Fig. 3, to another four-speed unit gear box mounted on top of the machine. This box controls all of the feed movements and feed speeds. The horizontal driven shaft from this box extends from

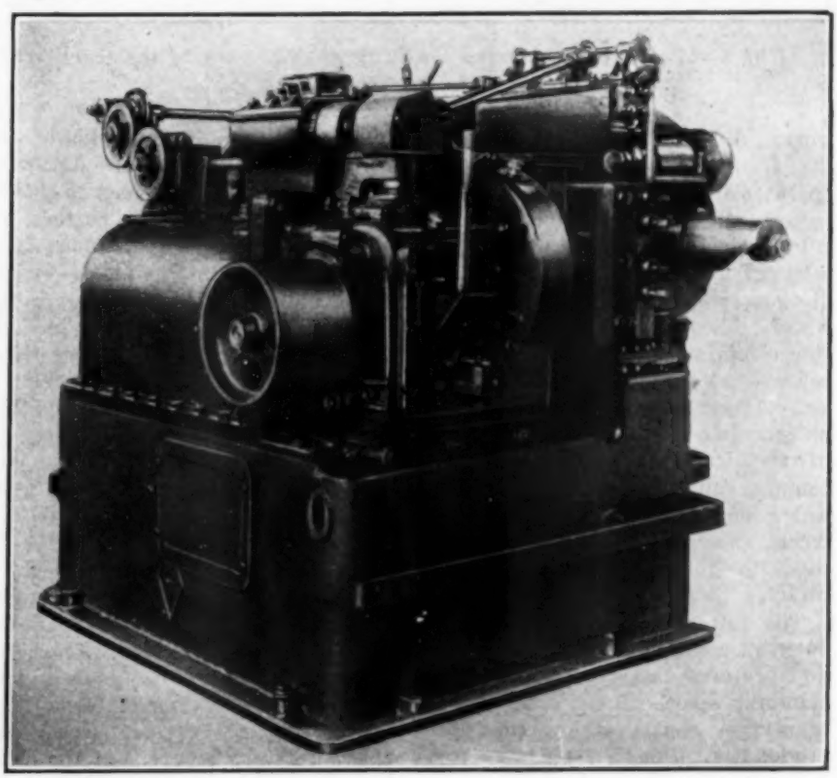


Fig. 3—An end view showing the speed box and drive pulley

SHOP EQUIPMENT NEWS

both ends. It drives from one end to the two index box worms and from the other end, which can be seen emerging from the box in Fig. 4, to the main dividing head through the set of pick-off change gears. These gears provide for the proper rotation ratio between cutters and work. A lever, Fig. 1, mounted on the front of the machine for the operator's convenience, sets or disengages these feed movements.

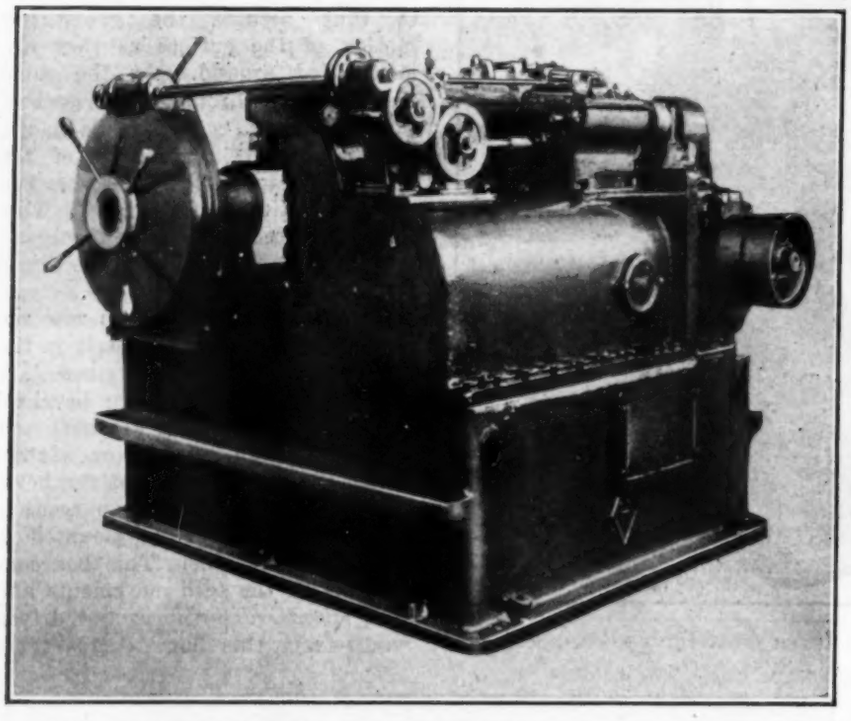


Fig. 4—A rear view showing the feed-change gears to the work-rotating head

Provision is made, to assist in setting up, for disengaging the dividing head worm and its wormwheel. Two clamps, shown on the side of the worm housing in Fig. 1, release the worm bearing from its set relation to the wormwheel and an eccentric cam, operated by means of the lever shown between the clamps, can be rotated to lift the worm out of mesh. The capstan wheel, shown in Fig. 2, can then be used to rotate the work spindle direct.

The cutters can also be independently disconnected from their drive and rotated after loosening the clamping screws on the ends of their respective shafts where they protrude, Fig. 1 or 2, from above the index boxes. These clamping screws hold clutches in engagement, which are made with fine V-teeth that permit of minute adjustment of either cutter in either direction. In fact, one cutter can be set with relation to the other, so that a gear can be generated with staggered teeth by any amount instead of being continuous. While there is no object in so doing, the possibility is an indication of the flexibility of the design. Actually, this adjustment is provided to enable the operator to set the cutters, in accurate relation to each other.

The friction clutch which is interposed ahead of the speed box is to guard against mishap. Should binding in the drive for either the work or cutter rotation occur, the clutch will immediately slip and stop further movement of both. There is thus no possibility of the cutters getting out of relation to the work after once being set and adjusted.

It is of extreme importance to the successful operation of the machine that there be no lost motion between the worms and wormwheels in the index and dividing heads. The cases for both are, therefore, made in two pieces and are shimmed for adjustment between bearing center distances as wear occurs. At the most, however, such wear would be very slow, as worm and wheel run in oil.

In the smaller machines the work is advanced, while in the larger ones, when the size of gears to be cut and the necessarily large main dividing head and support bearing make the assembly unwieldy, the slide and its driving mechanism are mounted on ways. Such an arrangement is shown in Fig. 5, which illustrates one of the large machines at work.

The handwheel on the front of the smaller machine, Figs. 1 and 2, is used to advance the work after each complete revolution until the proper depth is obtained. To assist in this, a micrometer scale and pointer are provided on the lead screw. The advance is effected by moving the work saddle on its ways on the bed, and in order that this motion shall not affect the relation between work and cutter, due to its advancing and dividing head, the dividing-head worm slides on a driving spline.

There is, finally, one other set of motions essential to the machine action, for relieving the cutters from the work so there will be no drag on their return stroke.

The heads on which the cutters are carried have $\frac{1}{16}$ in. of free end-play on the cutter bases of the machine illustrated in Fig. 1. The faces of the bases and heads, while being parallel vertically with the main slide, are tapered toward the slide by 6 deg. horizontally, their low sides being toward each other. Guides, at the top and bottom, confine the heads to accurate contact with their bases. Shoulders at both ends limit the travel and back up the head for the cutting stroke.

A splined shaft that is carried independently of the heads, in bearings on the bases, has two cams of the plate type, mounted to slide on it, one for each head. They act positively against rollers carried on top of the heads, one on each side of each cam.

This shaft is driven through another set of shafts and bevel gears, that can be seen in Figs. 1, 2 and 3, deriving power from the vertical drive shaft in the speed box at the rear. The cams are designed and timed so they hold the heads stationary with respect to the work longitudinally at the two instants of reversal of direction of the slide so the next $\frac{1}{16}$ in. of slide motion moves the tapering bases under the stationary heads.

SHOP EQUIPMENT NEWS

The effect is to move the cutter, which is about to back up, away from the work and to set the one, which is starting to advance to take a cut, into position. All cutting is from the edge of the work to its center where each small chip left by the retiring cutter is broken off by the one approaching from the other side.

Side motion alone would have the effect of seriously binding the cutter shafts and the helix cams, were not provision also made to move the index heads so the shafts and cams will stay parallel to the face of the main slide.

To accomplish this movement the index heads are movable, front and back, in guides which can be seen in Figs. 1 and 2. Stops are provided at the front, that can be adjusted by means of the setscrews shown. Compression springs, mounted around the screws, hold the head toward the back of the machine. Cams, on a horizontal shaft back of the heads, receive power from the vertical shaft and bevel gears shown in Figs. 1 and 2, which lie between it and the set of gears and shafts that drive the cams on the cutter heads. Thus, the cutter heads are moved back or are advanced by the cams and springs in step with the movement of the cutter heads, and the cutter shaft alignment is maintained.

A pump for flooding lubricant on the work is mounted in the rigid box-type base which is provided with a trough around the front and one end to catch the flow and return it to the reservoir, also inside the base. A cut-out in the base under the work allows the chips to be caught in a pan and removed and the bulk of the returning lubricant to be caught and strained direct.

The high-speed shafts are carried by ball or roller bearings. The cutter spindles and their bearings are of case-hardened steel. The two are ground and lapped to an exact fit. The gears in the two change boxes, the index boxes and the dividing head are immersed in oil of comparatively heavy body.

As stated, there are four machines in the series, a No. 1½, which has been described, will cut from the smallest up to 8-in. face by 18 in. diameter; a No. 2 has a range up to 12-in. face by 30-in. diameter; a No. 4 will cut 18-in. face and 53-in. diameter, and a No. 12 illustrated in Fig. 5 will accommodate gears of 54-in. face and diameters that measure up to 18 ft. and 6 inches.

An additional size, No. 6, which will cut gears up to 72 in. in diameter, is being developed.

The Nos. 1½, 2 and 4 have 4 speeds and 4 feeds and the No. 12 has 8 speeds with 2 feeds in a gear box to a set of change gears that will give an infinite number at the work. In addition, the No. 12 is driven by a variable-speed motor.

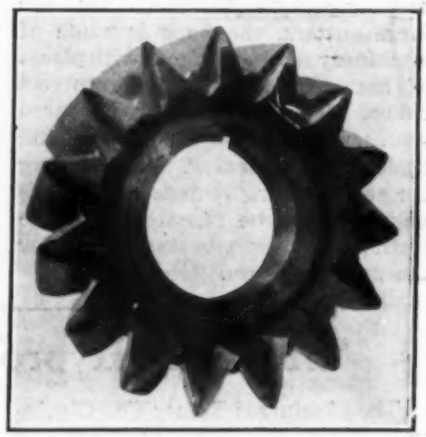


Fig. 6—One of the cutters

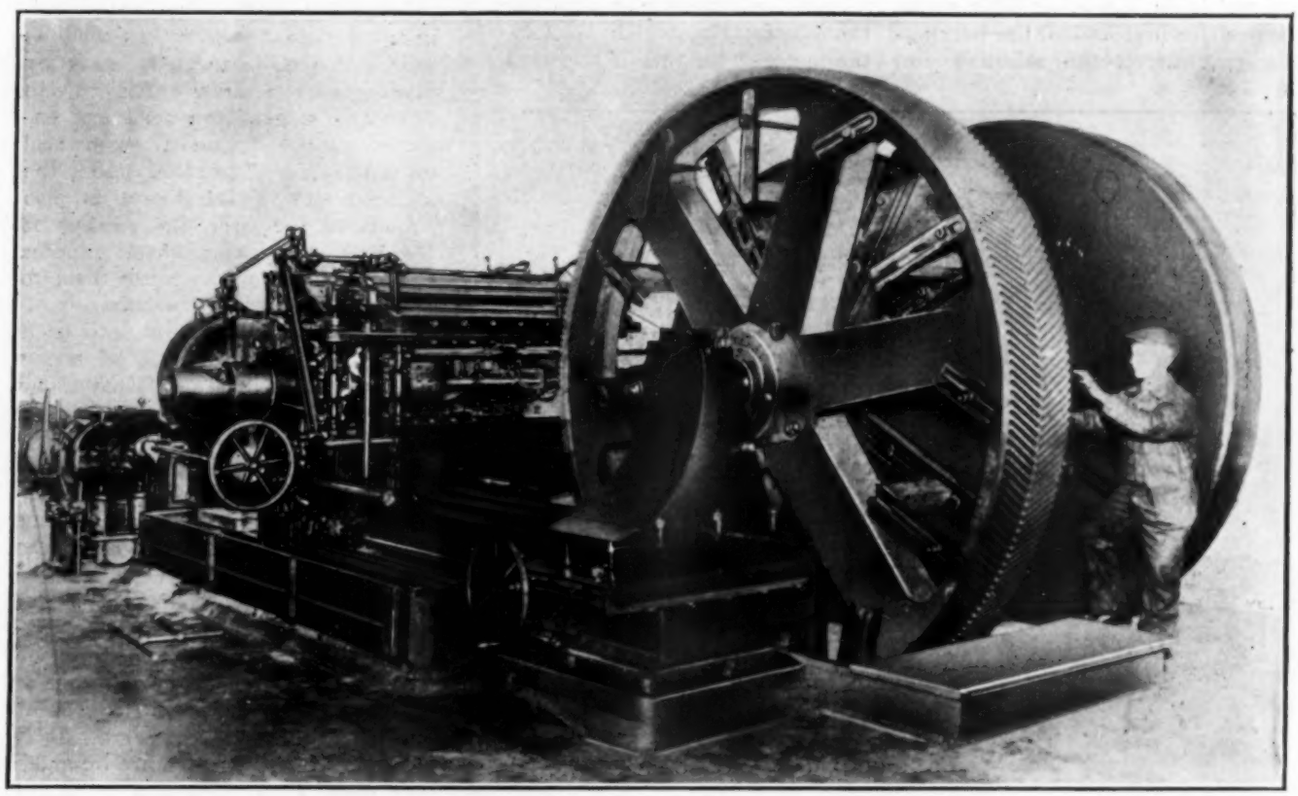


Fig. 5—A job on one of the larger machines

SHOP EQUIPMENT NEWS

In Fig. 6 is shown one of the cutters made of solid, high-speed tool steel. These cutters are roughed out and then ground on special machines for the contour and sharpened on an ordinary toolroom grinder. The shape of the face is an interesting and important feature. On the large cutters, the back is made of machinery steel and faced with pieces of high-speed steel of the correct shape. These pieces are secured with screws and may be removed and replaced as necessary. All grinding for resharpening is done on the face only and can be repeated until the teeth are too short to stand up under the cutting strain.

It is a feature of the machine that but one pair of cutters is needed for a given pitch regardless of the gear diameter, and any gear or pinion cut with a given set of cutters will mesh with any others, regardless of the size, that are made from the same cutters.

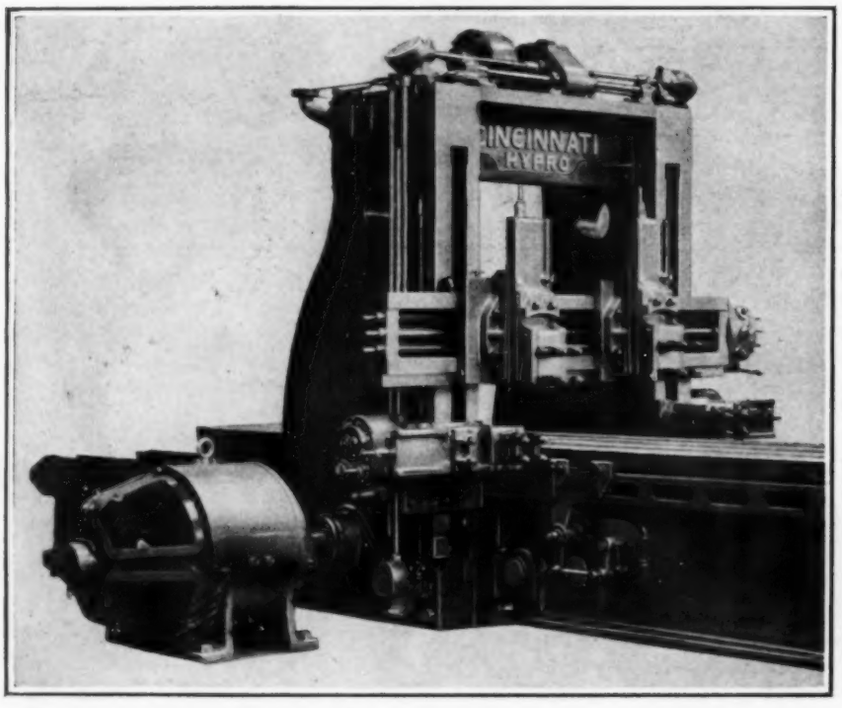
In the assembly of the machine itself, care has been taken to make all of the fits as accurate as possible. Sliding bearings are scraped and individually fitted. Shafts are ground and polished to the bearings in which they are to run, and the gearing within the various worm and wormwheel assemblies is cut with all possible accuracy.

Cincinnati Hypro Planer, 48-Inch

The Cincinnati Planer Co., Cincinnati, Ohio, has recently completed construction on the first 48-in. size of the Hypro line of planers previously announced and described in detail on p. 513, Vol. 62, of the *American Machinist*.

All of the features origially incorporated, and including the double-length bed, the box construction of bed and table, the inner table guide, the positive lubrication, the herring-bone-gear drive, the selective dial feed, the rail-clamp device, the rapid traverse, the inverted-dovetail construction of the slides and a number of other points, have not been changed.

The principal change, which is a comparatively minor one, has been made on the heads which have been further strengthend by the addition of a rib on the two sides. The present construction can be seen in the illustration, which is taken on the motor-drive side of the machine.

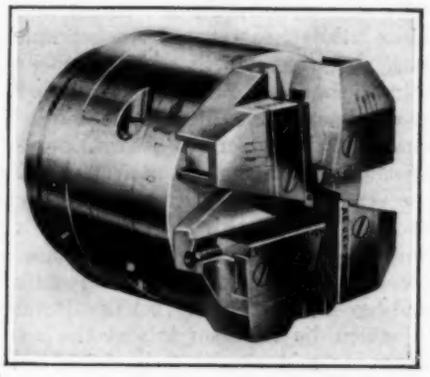


Cincinnati Hypro Planer, 48-Inch

Lanco Thread-Cutting Diehead

The Lanco diehead, manufactured by the Landis Machine Co., Waynesboro, Pa., is intended for use on automatic, semi-automatic and hand-operated threading machines, and is designed to accommodate the Landis "long-life" chasers. It is made of high-carbon steel, heat-treated and ground.

A series of graduations are laid off around the body near the rear end to assist in setting the chaser



Lanco Thread-Cutting Diehead

holders for cutting various standards of threads, screw as well as pipe. The adjustment is made by turning a worm-screw which projects from the side of the head and engages with teeth on a wormwheel on the inside. The collar under the squared end of the worm is also graduated for very fine setting of the dies. The wormwheel actuates the chaser holders to cause them to swing to the desired position.

The chaser, which fits into each holder, is backed up by a set screw and is secured firmly in place under a clamp which is set above it.

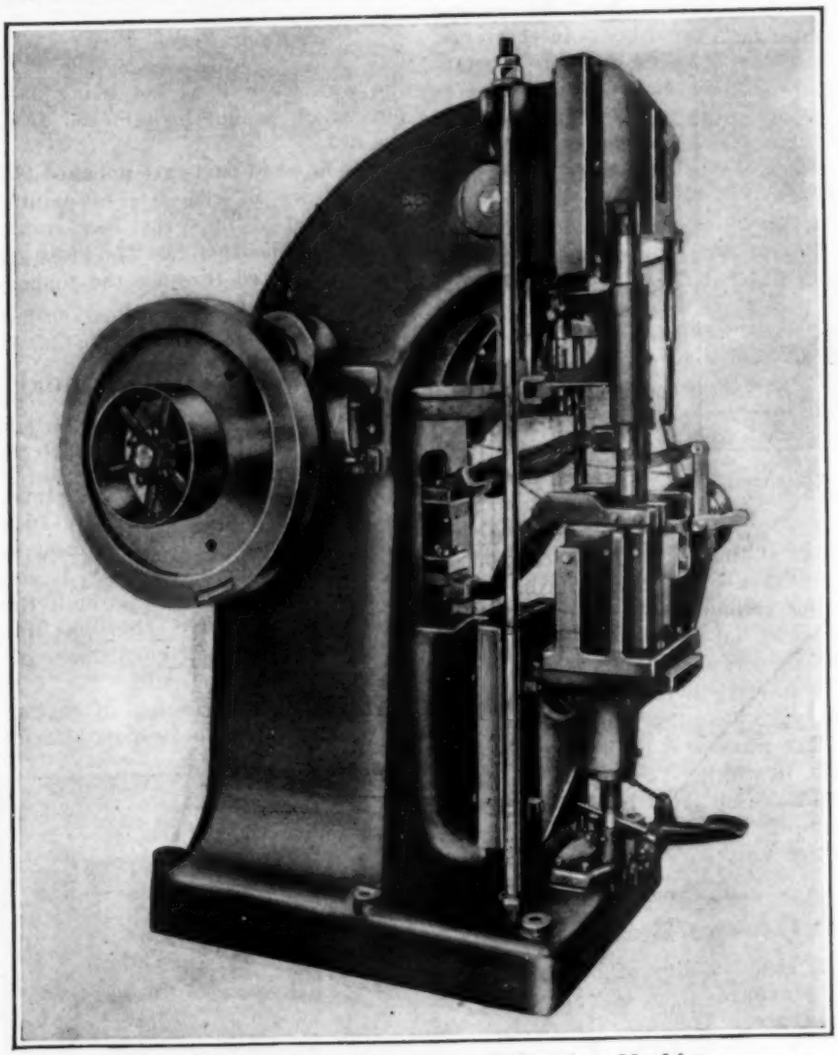
The head, when at work, is locked within itself through the engagement of two closing pins which operate in hardened bushings. Closing and opening is automatic when the head is in operation.

The company has aimed at a design which keeps all of the passages and openings into the interior of the head completely covered, while the head is in operation, to prevent chips and dirt from entering. It is made in five sizes which are intended for work $\frac{3}{8}$, $\frac{7}{16}$, $\frac{3}{4}$, 1 and $1\frac{1}{2}$ in. in diameter respectively.

SHOP EQUIPMENT NEWS

Kobert Electric Riveting and Forging Machine, Type NC

The Kobert Machine Division of the National Equipment Co., Springfield, Mass., announces an improved model of its type NC, electric riveting and forging machine that is adapted to the manufacture of socket wrenches, poppet valves, accumulator plungers and a variety of similar machine parts of brass, iron or steel that may be formed under pressure while at a forging heat. The principles of the original machine, described on page 1010, Vol. 57, of the *American Machinist*, are retained, the new machine being made larger and heavier as well as being adaptable to a greater variety of work.



Kobert Electric Riveting and Forging Machine Type NC

The forming is done in dies, made to accommodate the work, and the forging blow and pressure is delivered through the medium of a ram and lever that is actuated by a crank. Electric current to heat the work is applied through a copper electrode that is first brought down into contact with it by depressing a treadle. The heating current is supplied by a transformer that is a part of the machine equipment and is delivered at a low voltage and of sufficient amperage, within the capacity of the transformer, to raise the temperature of the work to forging heat.

The lever that transmits the movement of the crank to the ram is provided with a safety feature in the shape of a cushion of heavy coil springs adjusted to deliver the full pressure required. If this pressure is exceeded, by reason of misplaced work or insufficient heat, the springs will be compressed and the crank thus allowed to complete its cycle without damage to the mechanism.

The cycle of movements is as follows:

The operator places a piece of work—cold—in the dies and closes them upon it. The upper electrode, being above and in line with it, is brought down to contact with the work by depressing a treadle. As soon as the electrode contacts with the work and can move no farther, continued movement of the treadle closes an electric switch in the primary circuit of the transformer and causes the current generated in the secondary coils to flow through the work.

The treadle is held down until the temperature of the work reaches the desired degree, when it is released and returns to its original position by the action of a spring. As the treadle rises, it first opens the switch and cuts off the supply of current to the primary coils of the transformer, thus stopping the flow without breaking the secondary circuit to prevent arcing at the work.

The electrode then rises from the work and is displaced sidewise by the upper tool, which swings into position as the ram starts to descend, the clutch in the flywheel having been tripped by the rising treadle.

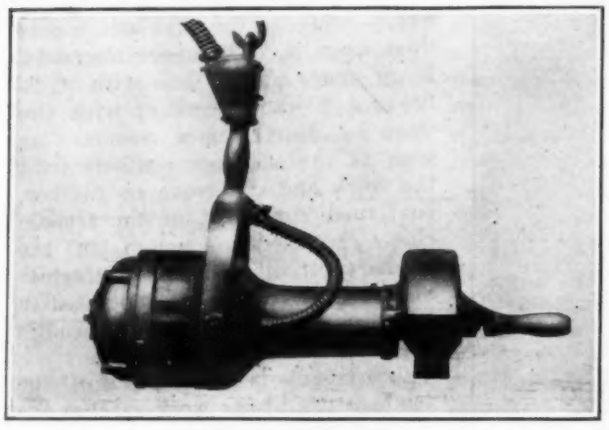
The crankshaft makes one revolution, causing the upper tool to strike the work with a quick, sharp blow. Then, as the ram approaches its lowest position, the springs of the connecting lever are compressed and the work held for an appreciable time under pressure. Water circulation is provided in the dies to prevent the temperature from rising too much above normal.

The machine is intended to handle circular pieces up to a diameter of $\frac{3}{4}$ in. and corresponding areas of other shapes. It is driven by belt from an overhead line or from an electric motor mounted in any convenient location. About 3 hp. are required. The transformer is of 25 kw. capacity. The throat depth is 24 in. A floor space of 52x72 in. is required. The weight is 7,000 pounds.

SHOP EQUIPMENT NEWS

Roth Brothers Portable Grinding and Polishing Machine

For smoothing off the rough spots of castings, especially those that are too heavy to handle on a floor machine, and for polishing large surfaces, the Roth Brothers & Co., 1400 West Adams St., Chicago, Ill., have placed on the market a portable grinding and polishing machine, shown in the illustration.



Roth Brothers Portable Grinding and Polishing Machine

The machine has been designed for ease of control, being counterbalanced to operate with a minimum amount of labor. The entire unit is suspended by a cast-steel yoke so the wheel end hangs slightly lower than the motor end, it being claimed that this feature insures smoother operation with the least effort by the operator. The handles are conveniently located to take advantage of the weight of the machine while in operation. A handle has been placed on the outer side of the wheel to give a more uniform control.

The rotor assembly consists of a high-carbon steel spindle of large size mounted in two ball bearings. The bearing at the wheel end is a combination of ball and thrust located next to the wheel. This construction permits the use of the side of the wheel as well as the edge. The end of the spindle is provided with square threads and a bronze locknut for holding the wheel in place. The nut is made of bronze so as it will receive the wear through use, thereby prolonging the spindle life and making the replacement required small in cost. The rotor assembly is balanced to reduce vibration.

The wheel-end bracket is made of cast steel, heavily ribbed on the inside, and small in diameter to permit the use of a worn wheel. The wheel guard is also made of cast steel and can be either clamped securely in place or allowed to revolve at the will of the operator so that deep concave surfaces may be ground without interference. The motor is substantially designed to stand hard foundry service and is made similar to larger a.c. motors built by the company. It is of the squirrel-cage type, 1 hp., 220 volts a.c., furnished to operate at either 1,800 or 3,600 r.p.m. All electrical connections and ball bearings are completely inclosed and dust proof. Provision for oiling has been made by locating two plugs at the bearings. Either oil or light grease can be used, the latter being recommended. An eyebolt is provided on the supporting yoke so the unit can be hung conveniently. The starting switch is also located on the yoke near the handle.

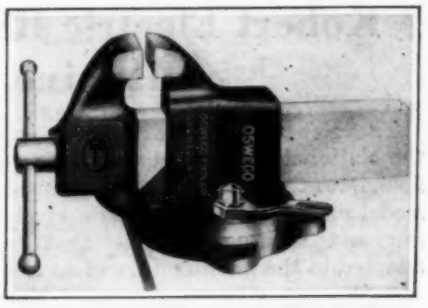
The wheel is 8 in. in diameter and 2 in. in width. The overall length of the machine is 30 in. and the diameter of the motor is 8½ in. The entire unit weighs 100 pounds.

Oswego Bench Vises

A complete line of bench vises in all standard sizes is announced by the Oswego Tool Co., Oswego, N. Y.

The main castings of the vise are of high-grade cast iron while the removable steel-face jaws are made of chrome-molybdenum steel. The faces of the jaws are serrated with closely divided lines and give a secure grip with a minimum of marking on the work. The screw is made of steel throughout and does not have a cast-iron head.

The patented, improved side nut is made up of a special hexagon nut with an inserted pin. The nut is operated with a hexagon wrench which can be thrown back out of the way when it is not being used but which cannot be removed from the nut.



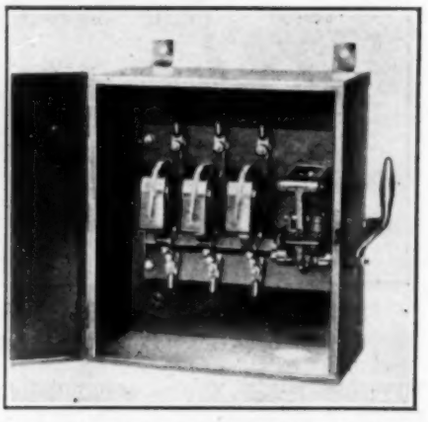
Oswego Bench Vise

The finished parts are polished and the balance of the vise is painted with a coat of blue-gray, heat-resisting and oilproof paint. The vises are being marketed through the jobbers and hardware dealers.

General Electric Manual Contactor, Type CR-1049

The General Electric Co., Schenectady, N. Y., has added the CR-1049 manual contactor to its lines of motor-protecting apparatus. It can be used for disconnecting both the motor and its control from the line under practically all conditions, except a dead short circuit.

The equipment consists of contact elements mounted on insulated shafts and connected through a snap-action mechanism to the operating handle on the outside of a sheet-steel inclosing case.



General Electric Manual Contactor, Type CR-1049

Both the case and the handle can be locked in the open-circuit position to prevent unauthorized persons

SHOP EQUIPMENT NEWS

from closing the contacts. The contactor will open the circuit with full safety to the operator without attention on his part.

Silver contact tips are used on all sizes, with the exception of the 50-ampere size, to cut down the contact resistance. The box has been proportioned to allow ample room for completing and soldering the connections.

Four sizes of the equipment are being manufactured, for 50-ampere capacity in 3 poles, for 80 and 150 amperes in 2, 3 and 4 poles, and for 300 amperes in 2 and 3 poles.

McCall Hydropress Series No. 50

The hydropress has been designed and is being manufactured by the McCall Machine Works, Rochester, N. Y., for such work as pressing gears and pulleys on and off their shafts, for setting bushings, for straightening shafts, for push-broaching work, for unit assembly wherever pressure is required, and for similar operations within its capacity range. The pressure exerted at any instant is recorded on a gage which is conveniently located.

The machine consists of a cylinder and a ram assembly mounted at the top of two columns, a resistance beam which can be set on pins through the columns at various positions above a base on which the columns are secured, a two-stage pump arranged for belt drive through a pulley and pair of eccentrics, and the gage and piping.

The cylinder is of steel and is designed with substantial strengthening ribs. A U-leather packing seals the fit between the cylinder and the steel ram which measures 4 in. in diameter and has a 15-in. travel. The ram is returned to the top of the stroke by the action of steel springs.

The columns are of steel measuring 3 in. in diameter. The resistance beam is a steel casting of sufficient strength to stand up under a 15-ton thrust. It is machined for its fit to the columns and on its top surface. A turret plate at the center provides clearance openings, of various sizes, for the work. The beam is counterbalanced in a manner similar to the ram, on substantial springs.

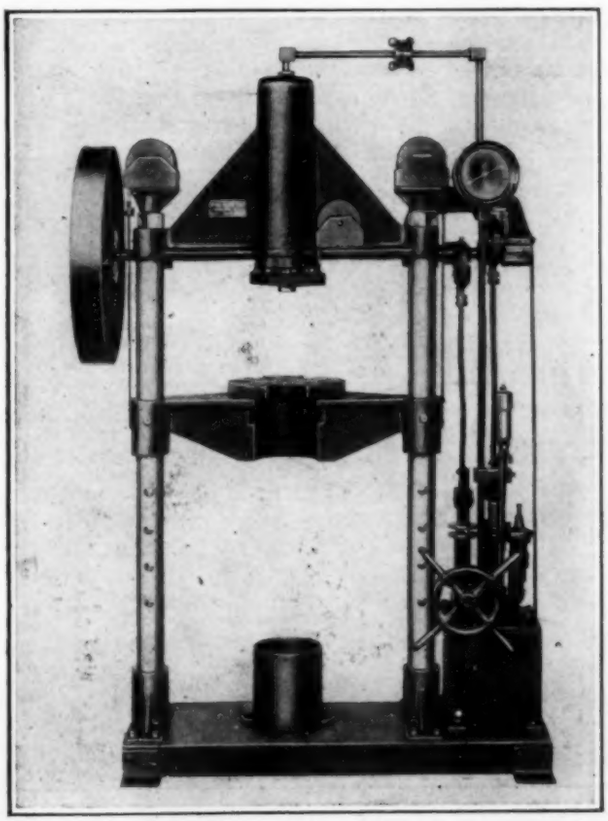
The base to which the column feet are secured is made of a piece of steel channel which extends to the right to provide a mounting surface for the pump. It can also be made long enough on the left-hand side to secure a drive motor to make the machine a self-contained unit. The pump eccentrics are intended to be rotated at between 75 and 150 revolutions per minute.

The larger of the plungers in the pump is used to move the ram to the work rapidly until resistance to movement is encountered. Its delivery is then by-passed to the water box on which the pump stands, and the smaller plunger raises the pressure to the desired point. An adjustable, bronze safety valve prevents overloading, while the gage, which registers the pressure in tons per sq.-in., keeps the operator informed of the force he is exerting.

A pot containing a lead bottom is bolted on the base below the turret plate to act as a buffer and catcher for arbors and similar parts which are being loosened for removal from other pieces.

The company stands ready, in addition to furnishing its standard machines, to design special equipment upon receipt of the detailed requirements under which it is to perform.

The capacity of the press is 15 tons. The clearance range between the ram and the resistance beam is 10 in. to 34 in. The opening through the beam is 6 in. The motor is recommended at 2 hp. The overall height is 6 ft. and 6 in., while the floor space occupied is 18 in. x 5 ft., including the motor extension. The net weight is 1,225 pounds.



McCall Hydropress, Series No. 50

Union Motor-Driven, Hollow-Chisel Mortising and Boring Machine

The motor-driven mortising and boring machine, illustrated, is a recent addition to the Union line of woodworking machinery being built by the Gallmeyer & Livingston Company, 346 Straight Ave., Grand Rapids, Mich. It is intended for use as a hollow-chisel mortiser but can be converted for plain vertical boring through the minor operation of removing the chisel holder.

The boring bit is driven by a ½-hp. motor which can be furnished for connection to a convenient lamp socket or to a power line. When specified, a 1-hp. motor can be furnished, but, for attachment to a power line only. The motor shaft is mounted on ball bearings and a ball-thrust bearing is also provided to back up the spindle.

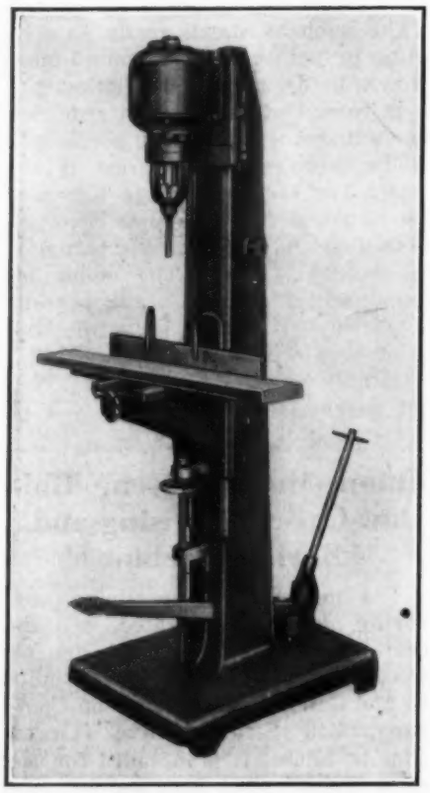
The spindle is machined to have a hole ½ in. in diameter and a bushing is furnished to reduce it to the standard for a mortiser-bit shank. When specified, an adapter can also be furnished to accommodate other standards of bits or to receive a No. 6 Jacobs chuck.

The motor is mounted on ways on the column. Its weight is supported by a spring and downward movement is attained through all or part of the

SHOP EQUIPMENT NEWS

3¾ in. of vertical travel by depressing a foot treadle which projects from the base. A stop and screw on the side of the column can be set to limit the travel.

The table which also slides on the column ways is carefully fitted so no clamping means is required after it is located at a desired point in its 17 in. of vertical adjustment. The



Union Motor-Driven, Hollow-Chisel Mortising and Boring Machine

setting is made or changed by rotating a lead screw between the table and the base.

There are two styles of table, the standard and the compound, the latter being an addition to the former in the shape of a means of feeding the work and is subject to specification.

The standard table has an in-and-out movement of 4¾ in., on gibed, dovetail ways, which is controlled by a lead screw and handwheel. There is also provision for tilting the working surface to 45 deg. on either side of vertical, without effecting the vertical setting. A maple top provides protection to the tools and clamps are added to hold the work.

The base of the machine is set on two wheels rigidly mounted on the front and on two solid points at the rear. A caster wheel can, however, be made to lift the rear end clear by means of a cam arrangement on the handle so the entire unit can be moved from place to place.

Regular equipment includes the ball-bearing motor with an extension cord, socket and switch and a ⅜-in. hollow chisel and bit.

If desired, the machine can be ordered as a vertical boring machine only, when the chisel holder and the hollow chisel and bit are omitted.

Elwell-Parker Elevator-Tructor Furnace Charger

An adaptation of its line of material-handling tructors has been made by the Elwell-Parker Co., Cleveland, Ohio, for use in connection with heat-treating operations by means of a special design of elevating load supports on its Elevator-Tructor. The unit is known as the furnace charger, and, as the name implies, is intended for lifting, conveying and depositing quantities of work in an oven or furnace and of picking this same work up after it has been heated and removing it from the furnace to handle it through succeeding operations.

The load support consists of two horizontal fingers upon which ten 300-lb. packed furnace boxes can be placed. The fingers are depressed into slots, which are arranged in the floor of the furnace when the charger is used, to transfer the weight to the furnace so the unit can be removed. The furnaces are set above the floor enough to clear the projecting front axle and wheels when the fingers are run into the furnace.

The fingers are 92 in. in length by 8 in. in width by 6 in. in depth. They are spaced with 10 in. in the clear between them, and are secured to two steel arms which are provided with hardened rollers riding on ball bearings to travel on renewable ways on the two upright steel channels. An arrangement of rack pinions, differential and cables connects the arms to the motor-driven hoist which is mounted above the battery compartment. The fingers can be moved from a minimum of 12 in. above the floor to a maximum of 72 inches.

The unit can be furnished with a double-drum hoist, such as is used on the company's portable crane when an extra cable line is required for additional pulling purposes.

The unit is propelled by an Ellwell-Parker electric motor and is steered on all four rubber-tired wheels. The drivers are 22 x 4½ in. and the wheels beneath the forks carry dual differentiating 10 x 6-in. tires.

The pots are packed, run over a conveyor to a rack two feet above the charging floor and are there picked up by the tructor.

Elwell-Parker Elevator Tructor Furnace Charger

SHOP EQUIPMENT NEWS

Cochrane-Bly Combination Cold Saw

The combination cold saw illustrated in Figs. 1 and 2 has been developed by the Cochrane-Bly Co., Rochester, N. Y., for use in cutting I-beams, channels and structural shapes at an angle, as well as to perform ordinary cross-cut work on shapes and flats.

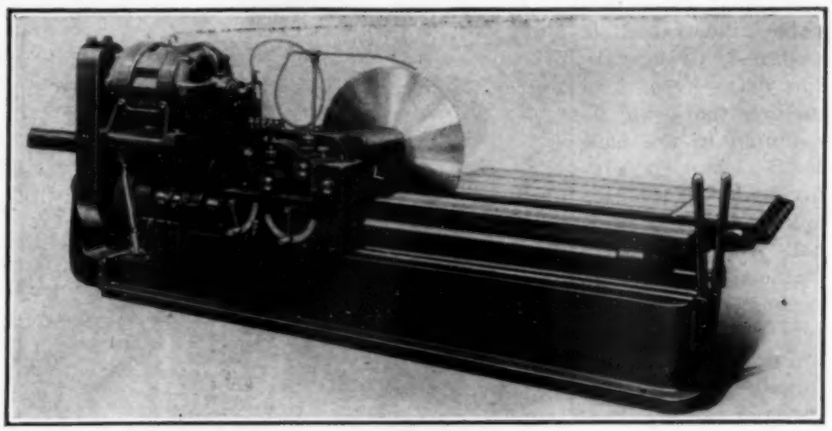


Fig. 1—Cochrane-Bly Combination Cold Saw

The machine has a 48-in. saw travel, and the design includes the company's standard mounting of the feed screw in a position close to the blade and above the ways, a construction which keeps the thrust of the feed closely in line with the resisting effort of the blade.

As illustrated in Fig. 2, an upper table can be mounted on the main table so the carriage will pass under the work to keep the cutting resistance in line with the carriage travel, rather than at right-angles to it, to eliminate tendency in the carriage to lift and to keep out vibration. This upper table can be removed, and the machine then has capacity for cutting 21 in. I-beams in a vertical position or bars 10 in. in diameter.

The saw arbor is geared to a brake band which acts to take up the slack in the driving-gear teeth and to thereby hold the saw blade steady when thin sections are being cut that necessitate set-ups which permit but one tooth to cut at a time and to release before the next one takes hold.

The saw is driven through a friction clutch and a sliding-gear transmission, the gears in which are made of nickle steel and are hardened. They run in a bath of oil. Speeds for cutting at 30, 40 and 60 ft. per min. are obtainable.

The positive feed is geared from the main drive to provide 11 changes that vary between ¼ and 2½ in. per minute. Rapid power traverse is also available in both directions.

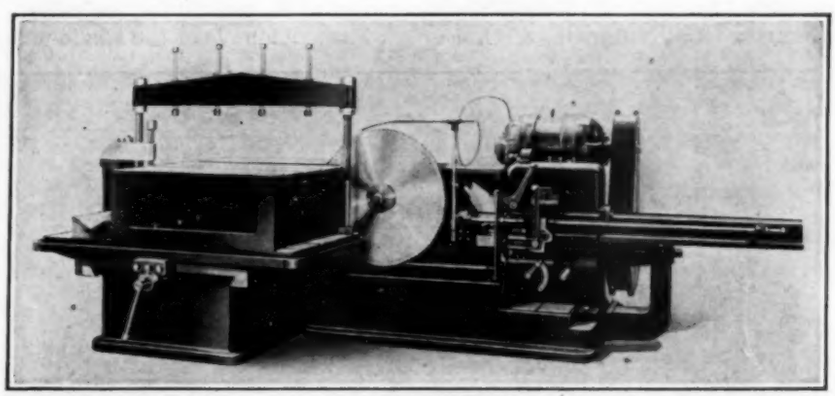


Fig. 2—The upper table in place

Controls are provided at both working positions in the front and at the rear, so the clutch, feeds and rapid traverse can be operated conveniently.

When the top table is used, the following figures give the capacity for the machine:

Flat sections 36 in., vertical sections 9¼ in., I-beams, square cut, 36x8¾ in., I-beams, mitre cut 25 in. by 8¾ inches.

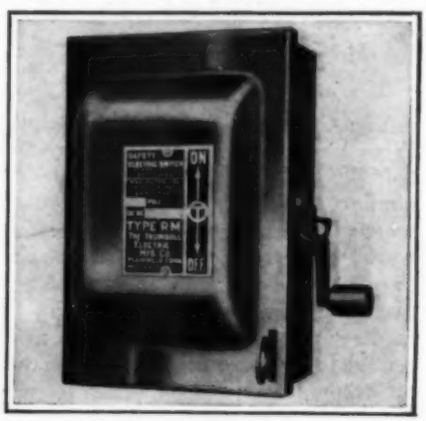
When the top table is removed and the work is set on the main table, the following sizes can be handled:

I-beam, vertical, square cut, 21x8 in., mitre cut 15x7 inches.

The machine has a capacity for face milling of 32x21 in. A 15-hp. motor is required. The floor space occupied is 6 ft., 6 in. by 13 ft., 2 in., and the weight is 15,000 pounds.

Trumbull Type-RM Motor-Starting Switch

The Trumbull Electric Manufacturing Co., Plainville, Conn., has brought out an addition to its line of motor-starting switches in the shape of the RM type, here shown,



Trumbull Type-RM Motor-Starting Switch

for starting motors of 3 hp. or less. It is of 30 ampere capacity, 250 volts, and is made in both two- and three-pole types.

All moving parts except the starting lever and all current-carrying parts are completely inclosed when the door is shut. Protection against unauthorized tampering with the switch is provided by means of lock or seal. The switch is constructed on the double-break principle, and when the blades move to off position they pass into deep slots in the base

SHOP EQUIPMENT NEWS

and snuff out any arc. The switch base, fuse-block base and rotor are all of high-grade material of unusual strength and will stand much abuse in handling.

There are three positions of the starting lever. When it is moved from the "off" to the "starting" position the fuses by which the motor is protected are automatically shunted out, thus allowing the momentary rush of excess current necessary to start the motor without causing the fuses to be blown. As the motor reaches normal speed the starting lever is eased back to "running" position, when the shunts are removed from across the terminals of the fuses and the latter are again in position to protect the motor from excess current that might be due to overload.

The lever cannot be left in "starting" position, but must be held there by hand while the motor is coming up to speed. When the hand is removed the pressure of a coil spring immediately causes the lever to fall back to "running" position.

Gardner 10-Inch, Double-Spindle Disk Grinder, No. 77

The Gardner Machine Co., Beloit, Wis., has added the No. 77 double-spindle disk grinder to its line of similar machinery to provide a unit which can be used to advantage for work on small parts which have parallel opposite sides or ends of approximately equal area to grind. It is designed so the work can be presented to the grinding disks by hand or automatically, depending on the nature of the grinding to be done. Its capacity includes parts which measure from ½ to 1½ in. in diameter, or outside dimension, and from ⅛ to 3 in. in thickness or length.

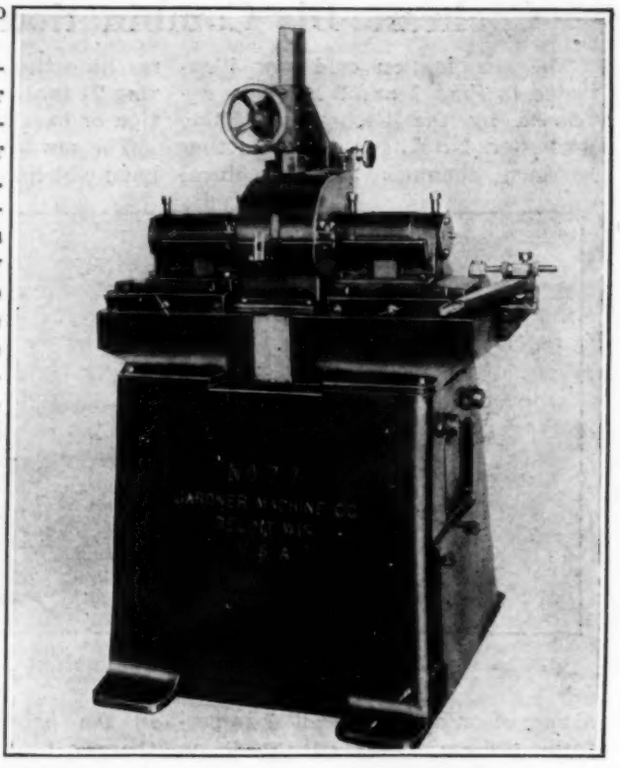
The grinding members consist of steel disk wheels measuring 8 in. in diameter, faced with the heavy-type Gardner G.I.A. disks previously described on p. 217, Vol. 62, of the *American Machinist*, or of 8x1x6-in. abrasive-ring wheels carried in shallow chucks of the straight-back type.

The grinding heads are mounted on dovetail slides that are fully protected from dust and dirt. They are moved by means of a hand lever providing a ratio of 12 to 1. Micrometer adjustment is also provided.

The machine is furnished for belt or for motor drive as desired, and in either the bench or floor type. The floor-type machine, illustrated, is designed primarily for drive from two motors that can be mounted in the base for belt connection individually to the two spindles. Individual belt tighteners are included with this arrangement. The motors within the base are protected. Ventilation is arranged for through screen-protected openings.

A device for truing the wheels is mounted on a rack and pinion arrangement on top of the machine. The assembly can be moved and set laterally to center it between the two faces, and is actuated by means of a handwheel on the pinion shaft.

The floor-type machine weighs 1,225 lb., while the bench type, which is essentially the same in design, except for the base casting, weighs 650 pounds.

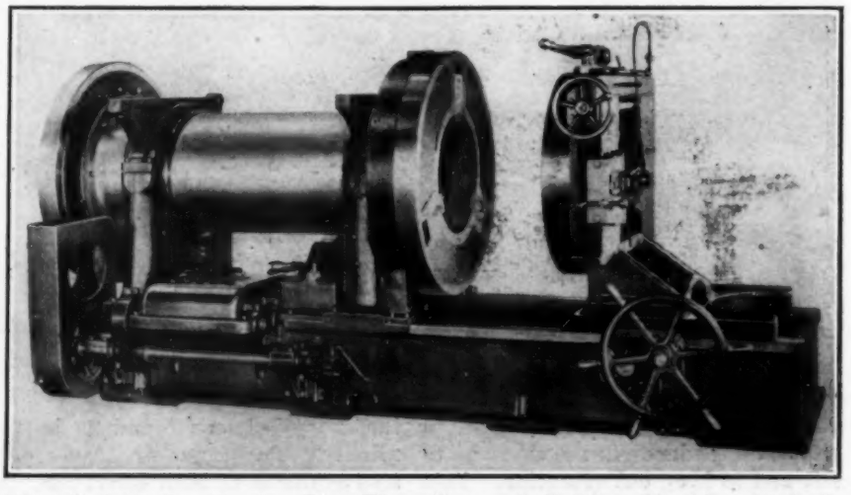


Gardner 10-Inch, Double-Spindle Disk Grinder

Bignall & Keeler Duplex Pipe-Threading and Cutting Machine, 20-Inch

The duplex pipe-threading and cutting machine, illustrated, has been developed by the N. O. Nelson Manufacturing Co., Bignall & Keeler Works, Edwardsville, Ill. It will handle pipe that ranges in size between 10 in. and 20 in., inclusive.

The machine is of the single-pulley



Bignall & Keeler Duplex Pipe-Threading and Cutting Machine, 20-inch

SHOP EQUIPMENT NEWS

type and is recommended to be driven by a 10-hp., constant-speed motor. The arrangement illustrated is for a belt drive, but this can be changed to motor drive by mounting the motor at the top and connecting it through a reducing gear and a silent chain.

Speed changes are provided for in a compact gear box which is made a part of the machine bed and which houses, in an oil-tight inclosure, a train of steel gears. The gears run in a bath of lubricant.

The dies are of the Peerless type, skip tooth. There are 12 pieces to the set, all being provided with eccentric relief. These dies are held in one diehead which accommodates all of the various pipe sizes, and the arrangement obviates the necessity of employing any special tools to change the setting from one size to another.

At each end of the arbor is a 3-jaw independent chuck. The one at the rear has flange grippers for making up or breaking flanged-fitting connections. The front chuck which drives the pipe is located close to the housing and is bolted to the master gear.

Cutting lubricant is supplied under pressure from a reversible geared pump which is equipped with suitable piping and control valves.

The complete machine occupies a floor space of 5x13 ft. and weighs 26,500 pounds.

Timken Improved Tapered Roller Bearing

Refinements have been made in the design of its line of tapered roller bearings by the Timken Roller Bearing Co., Canton, Ohio, and the improved tapered roller bearing is now in production.

Nickel-molybdenum steel of special Timken formula has been adopted for all bearings. The design of the roll has been changed so the surface of the large end is at right angles to the center of the roll. This has brought about contact in the two areas between the large end of the roll and the rib of the cone, together with line contact between the surfaces of rolls and cup. The arrangement is said to result in self-alignment of the rolls on the cone without resorting to a cage fixture to maintain the relation.

The primary purpose served by the cage is to retain the rolls properly spaced about the cone and to make the cone set of rollers a unit assembly.

The cage has been improved by the use of a multiple die to perforate all of the pockets at one time. Distortion during this operation has been obviated by retaining an inwardly turned flange on the small end of the cage. The lateral edges of the cage are swedged inward so the contour of the sides conform to the contour of the roll, another tool being used which performs the work at one operation.

Timken Improved Tapered Roller Bearing

After completion, the bearings are tested for sound, as well as other points, by means of an electrically-operated machine which eliminates the human element and registers the sound-producing characteristics of each bearing on a dial.

It is said that friction has been reduced, that higher speeds are practical, and that wear with proper treatment is a negligible item.

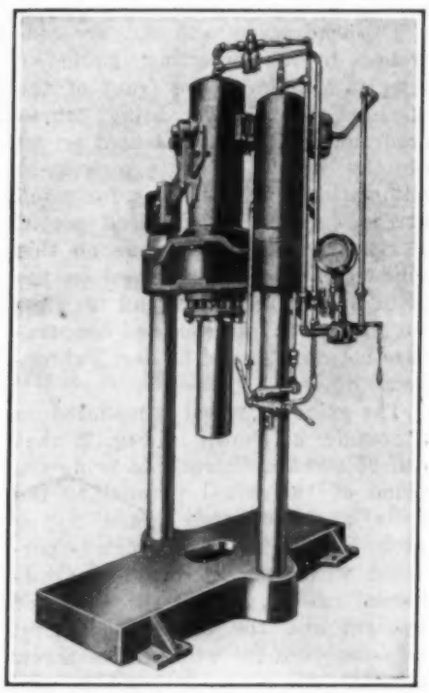
In the illustration a broken section of the inner race is shown with one of the rollers in place. The undercut at each side made for clearance can be seen as well as the effect of the heat-treatment given the part to refine the metal in the race.

Watson-Stillman Two-Rod Hydro-Pneumatic Forcing Press

The hydro-pneumatic forcing press which is being built by the Watson-Stillman Co., 50 Church St., New York, N. Y., is designed for operations involving forcing, pressing, and bending. The machine is primarily intended for use in railroad shops and in other large companies.

The press provides means for pressing bushings in and out, for placing and removing press-fit gears, and, with its long bottom platen, for operations of bending and straightening.

The press is of the two-rod type and has a downward ram movement. This movement is actuated by a hydro-pneumatic combination which takes its initial power from the compressed-air lines in the shop. Separate control is provided for the pneumatic side and for the hydraulic lines. The valves are conveniently placed and a gage located near them indicates the pressure being exerted. A jib crane included with the machine is mounted at the top of one of the columns. The press illustrated has a capacity of 100 ton. The bottom platen is 72 in. in length and is provided with a center hole.



Watson-Stillman Two-Rod Hydro-Pneumatic Forcing Press

SHOP EQUIPMENT NEWS

Société Genevoise Thread-Grinding Machine

The R. W. Ferner Company, Investment Building, Washington, D. C., announces a thread-grinding machine which has been developed by the Société Genevoise, Geneva, Switzerland, for correcting changes in screw threads due to hardening processes. It is intended for highly accurate grinding work on screw gages, lead screws, nuts and similar parts.

The machine is a complete unit as illustrated in Fig. 1 and should, therefore, not be confused with the grinding apparatus which is designed for attachment to a lathe. The slides are completely inclosed and are prtected against the penetration of water and emery dust. Its 5-pitch lead screw is cut to a high degree of accuracy and is guaranteed to be within a variation of 0.0001 in. for a length of 12 in., with shorter lengths proportionately closer.

The lead screw and nut are controlled by a correcting guide or templet located at the front of the machine, the templet being cut in accordance with the measured errors of the screw. The arrangement automatically compensates for small errors existing in the lead screw. Further provision is made on this guide so it can be adjusted on the pivot at its right-hand end to allow for pitches at any specified temperature between 32 and 68 deg. Fahrenheit.

The grinding wheel is mounted on a spindle, as shown in Fig. 2, that can be tilted sufficiently to bring the plane of the wheel parallel to the helix angle of the thread to be ground. The wheel support is porvided with two micrometer adjustments, one to control the depth of the cut and the other the lateral movements of the wheel in the screw thread. An eccentric lever is provided for quick withdrawal of the wheel at the end of the cut before returning it to the starting point. This is accomplished without altering the adjustment of the micrometer screw. Dials on the micrometer screws are graduated to read in the metric system to 0.005 mm. or to 0.0002 in. when the machine is specified for the English system.

The shape of the thread is obtained from the profile of the grinding wheel which is formed by the use of a special diamond-point dresser and a carriage capable of being revolved about a vertical axis. The movement is measured on a graduated circle reading to minutes that serves to regulate the profile angle of the wheel.

By fixing the carriage in its middle position and turning it about its vertical axis it is possible to give the edge of the wheel the rounded profile required for the flanks of the Whitworth thread.

A vertical micrometer microscope is fitted over the edge of the wheel to provide a means of checking the profile as it is being made and also to measure the angle, depth and pitch of the thread during the process of grinding.

The eyepiece of the microscope is fitted with two crossed wires at an angle of 60 deg. or, if desired for the Whitworth thread, at 55 deg. It is also provided with movable wires which are controlled by a micrometer reading to 0.0002 in. Illumination is furnished from below by the use of a right-angle prism and an electric lamp mounted in the base of the microscope support.

The work is mounted between dead centers, a work carrier being driven by an index finger mounted on a dividing plate carried by the face-plate. This dividing plate is graduated and can be moved relatively to the face plate for grinding screws with compound threads.

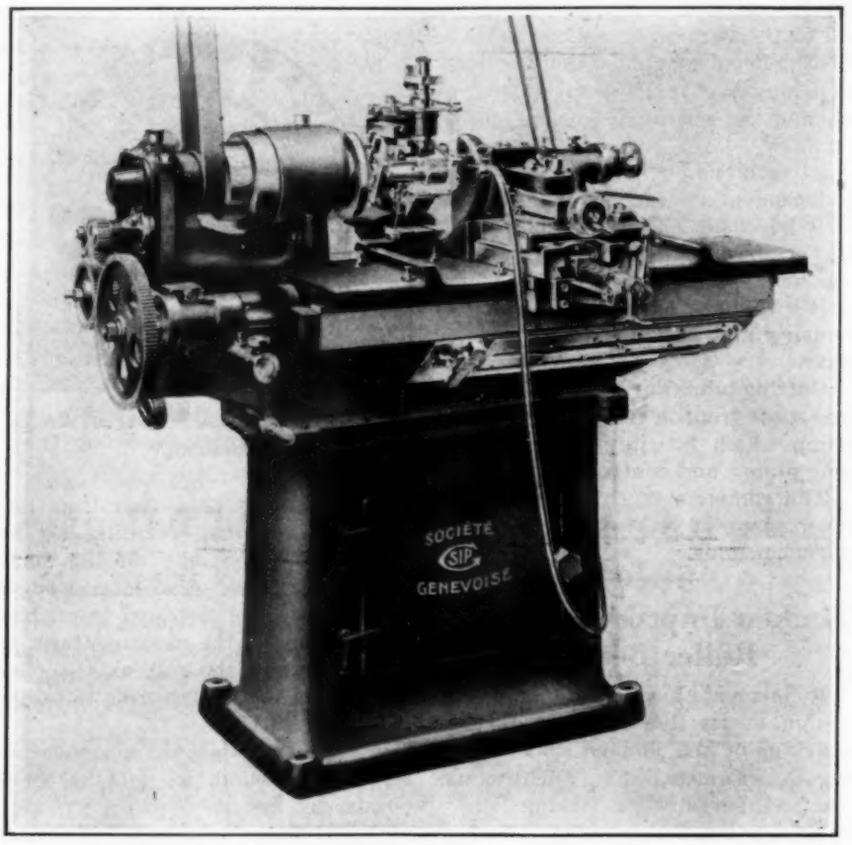


Fig. 1—Société Genevoise Thread-Grinding Machine

The first operation of grinding the outside diameter of a thread with a flat-face wheel is preferably carried out on an ordinary grinding machine, it being recommended that the Société Genevoise machine be reserved for pitch-correction and for crest shaping. If, however, the machine is used for this purpose the change wheels can be disconnected and the feed across the work accomplished by hand.

SHOP EQUIPMENT NEWS

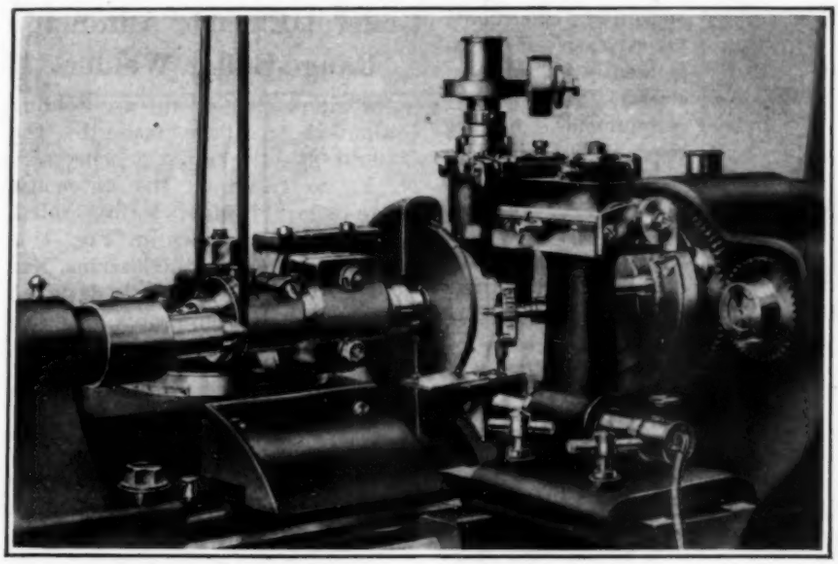


Fig. 2—The grinding wheel mounting from the rear

When grinding thread flanks, the grinding wheel is brought into contact with both flanks simultaneously. The motion of the wheel during grinding is from right to left when standing at the front. The distance between centers is 12 in. External threads up to 6 in. in diameter can be ground.

The machine can also be used for grinding internal threads between 1¼ and 5 in. in diameter, a set-up being shown in Fig. 3 for this class of work. The microscope cannot, of course, be used for examining the work during internal grinding but the simple positioning of the emery wheel makes it possible to frequently examine the profile of the wheel to insure the correct form of the thread.

Change wheels which are provided, for setting pitches from 26 to 3 threads per inch in 18 steps and for metric pitches, varying from 0.8 to 7 mm., in 16 progressive steps.

These change gears are mounted in a convenient position at the end of the machine as shown in Fig. 1 to the left.

A double drive is provided, giving 6 speeds to the work, that vary from 100 to 300 r.p.m., and revolving the grinding wheel at 1,400 revolutions per minute.

Round belt to an overhead countershaft is employed for the grinding wheel while a flat belt drives a cone pulley on the work-carrying headstock. The gears in this headstock are cut with helical teeth as Fig. 2 illustrates.

The machine is equipped with a carrier, a center, a faceplate, three grinding wheels with roughed out profiles and mounted in their bearings for external work and three for internal work. The net weight of the machine is about 1,430 pounds.

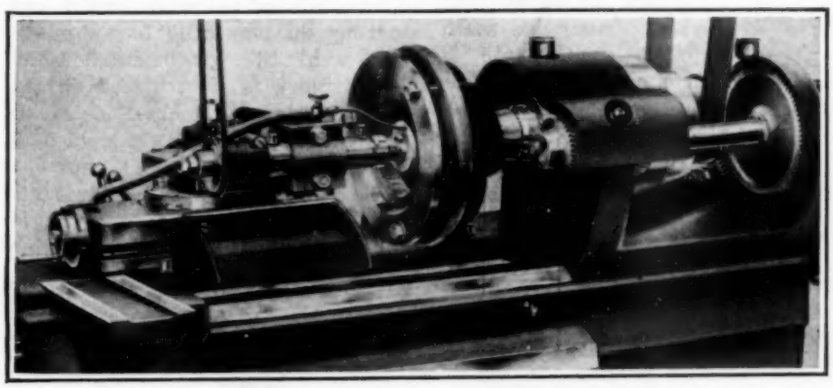
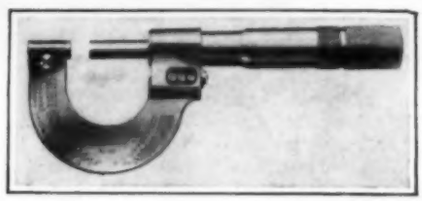


Fig. 3—A set-up for internal thread grinding

Brown & Sharpe Direct-Reading Micrometer No. 26

The direct-reading micrometer, illustrated, is a recent addition made to its line of measuring instruments by the Brown & Sharpe Manufacturing Co., Providence, R. I. The direct-reading feature consists of a set of numbered dials which are actuated by the movement of the measuring screw, and which eliminate chance of error in reading the value of a given setting. Steel indexing gears are used for connection to the dials.

Means are provided for adjustment of the measuring screw to compensate for wear. A cap on the end of the thimble can be removed to make an adjusting nut accessible through an opening in the side of the thimble. The company states that, due to this provision, it is unnecessary to return the calipers to the manufacturer when adjustment is needed.



Brown & Sharpe Direct-Reading Micrometer, No. 26

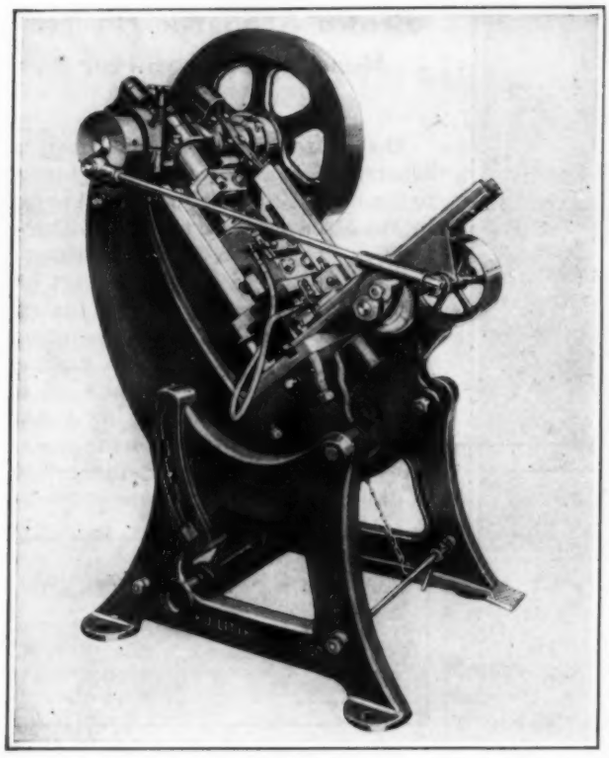
Littell Automatic Magazine Press Feed

The F. J. Littell Machine Co., 4123 Ravenswood Ave., Chicago, Ill., has added the automatic magazine press feed, illustrated, to its line of press equipment. The feed is intended for application to forming work on inclined presses.

It has been designed for placing work directly under the ram, from a magazine, without stopping at intermediate positions or pushing other pieces of work ahead. It is timed to meet each stroke of the press. The operator's efforts are confined to keeping the magazine filled, and as it is located in the clear, he is in no danger of getting his fingers caught under the ram.

A safety release is provided in case a blank should lock in the maga-

SHOP EQUIPMENT NEWS



Littell Automatic Magazine Press Feed

zine to eliminate the danger of breaking the feed. When locking occurs, a spring pin is unlatched and makes the feed pusher inoperative until the operator can release the part that is caught. It then closes and feeding is resumed.

The feed mechanism does not function to clear the die at the forming operation, this being taken care of independently by the purchaser. The company recommends using the punch to lift the work out, the positive bar-knockout to strip the punch after the work clears the die and compressed air to blow it out of the press.

The mechanism can be used for a wide range of work, as the design allows for the use of various shaped magazines and work pushers. It can be run at the rate of 70 to 75 pieces per minute.

The illustration shows the mechanism set up on one of the inclined presses which are also built by the company. Power to actuate the pusher is derived from the main crank to which a crank plate is attached. A connecting rod reciprocated by the movement of the crank terminates in a rack meshing with a gear on the side of the attachment to cause it to rotate through a partial circle. This rotary motion is in step with the ram movements.

General Electric Automatic Range-Boiler Welders

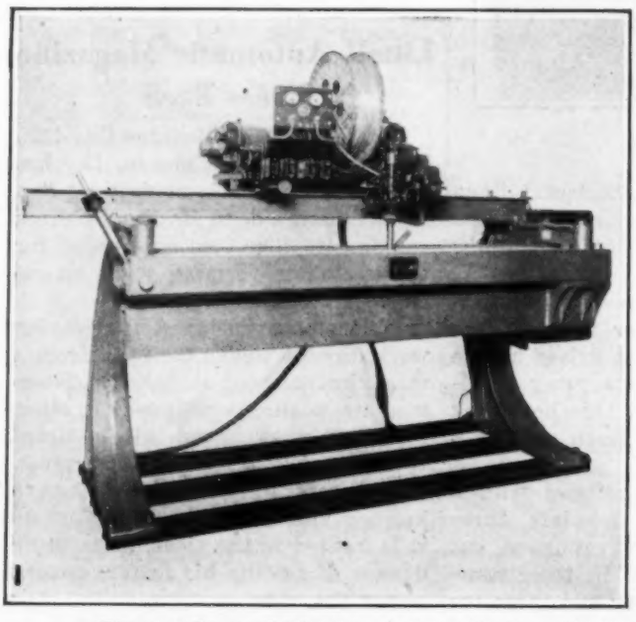
An adaptation of its arc-welding equipment has been made by the General Electric Co., Schenectady, N. Y., to result in the automatic range-boiler welders illustrated. The equipment shown in Fig. 1 is used on the longitudinal seams, and that illustrated in Fig. 2 is designed to weld the circular seams of range boilers and small tanks.

The machine for welding the longitudinal seams is especially designed to facilitate handling and securing the work. A pneumatic clamping device is operated by a small lever to grip or release the work automatically.

The machine for the circular-seam differs from the other substantially only in the apparatus which is used for rotating the tank under the welding head.

The cycle of operations consists of rolling the sheets the same as for riveting, tack-welding the cylinder in two places, setting it on the arm of the longitudinal seam welder and starting this machine to automatically weld the longitudinal seam. The cylinder is then placed on the circular welding machine, the heads are inserted and both are welded at the same time.

The equipment will accommodate tanks ranging from 11 to 33 in. in diameter and up to 6 ft. in length.



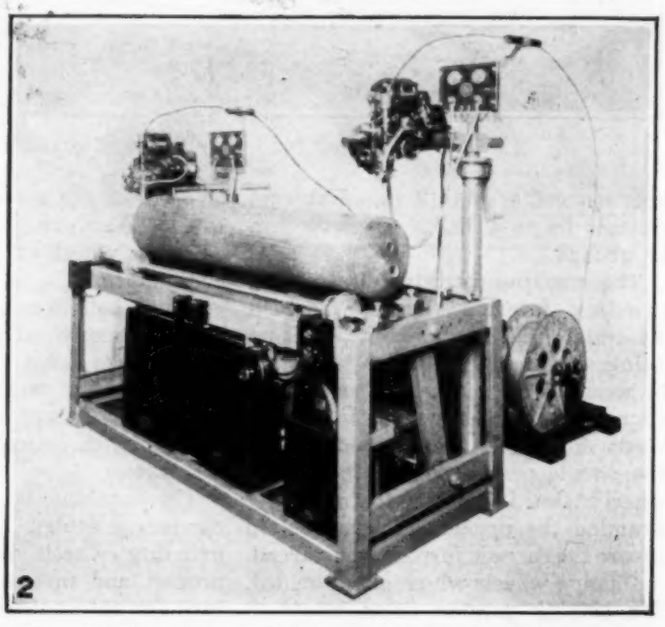


Fig. 1—General Electric Automatic Longitudinal-Seam Welder. Fig. 2—The machine for welding the circular seams

News of the Week

Washington Meeting on Simplified Practice Sets Standard for Grinding Wheels

Adopted sizes become effective on January first

Continuing its policy of assisting in eliminating waste in industry, the Division of Simplified Practice of the Department of Commerce held a meeting on Sept. 23, 1925 for the simplification of grinding wheel manufacture and use.

Under the leadership of Edwin W. Ely, of the Division of Simplified Practice, an interested and representative group discussed the various phases of the situation, bringing out the many factors governing the manufacture and use of grinding wheels.

As a preliminary to the discussion, Mr. Ely reviewed briefly the manner in which the Department of Commerce aided projects for simplifying practice in various industries. He reminded the group that the survey made under the auspices of the American Engineering Council showed an average yearly waste in all industry of 49 per cent, of which at least $10,000,000,000 is preventable. The metal working industry is the lowest in waste, being only 29 per cent, but still presenting many opportunities for improvement. This $10,000,000,000, incidentally, would pay all Federal and State taxes buy all the automobiles and keep them in fuel, and build the homes of the country.

Mr. Hoover, in an informal talk, pointed out that this work of his department was co-operative and not regulatory, and showed how the elimination of waste helped to stabilize industry by reducing the cost of manufacture and of distribution.

Lower Prices Through Less Waste

One effect of economical production in this country has been to lower prices on manufactured articles so as to enable a consumption of 15 per cent more per capita than was the case ten years ago. Mr. Hoover stated that no simplification conference had failed to secure results even though it sometimes took several days to reach an agreement, the average reduction of sizes on 12 commodities being 86 per cent.

The audience included representatives of the abrasive wheel makers, of makers of grinding machines, distributors and users. Geo. W. Chormann, of the Carborundum Co. outlined the work that had already been done by the grinding wheel manufacturers who had eliminated a large percentage of the wheels, as outlined in these columns last spring. Their elimination had replaced the number of items to be carried in stock by approximately half a million, and would greatly reduce the inventories of distributors and consumers as well.

It was pointed out by prominent representatives from the large automobile companies that many of the sizes of holes were made necessary to fit machines of different builders, which brought out the information that the leading builders of grinding machines were co-operating with the wheel makers and would conform to the sizes recommended. As a means of assisting users, Fred W. Smith, of the General Motors Corporation, suggested that the machine builders supply spiders or adapters so that wheels of the new standard could be used on their present grinding machines. This, according to Mr. Chormann, is already being done in some cases.

The machine tool builders will be asked to approve the new standard and their complete co-operation is expected.

Wheel makers pointed out that the selection of the sizes listed was based on the sales records of the makers and was not arbitrary in any sense. The adoption of this report does not mean that the wheels now in use could no longer be bought but simply that they would not be carried in stock by either maker or distributor. They can still be secured if time is given to make them, but it is, of course, hoped that these new sizes and shapes will gradually supplant those not listed.

The question of the grading of wheels was considered as outside the scope of this conference, as being a technical rather than a commercial problem. Mr. Chormann stated that a serious attempt had been made to adopt a uniform system of grading but that after two years work it had not been found feasible to do so.

After a thorough discussion the standards of the grinding wheel makers, as published on page 689, Vol. 62, of the *American Machinist*, were adopted, to become effective, for the manufacture of new wheels, on Jan. 1, 1926. In order to give dealers a chance to clear their shelves of old sizes, July 1, 1926 was named as the date on which only new sizes would be stocked for immediate delivery. A committee of eight is to be appointed to consider revisions when necessary. There will be two members from each of the interested parties, wheel makers, machine builders, distributors and users. Their names will be announced at a later date.

Any criticisms or suggestions concerning any phase of this important question will be appreciated by this committee. They can be addressed in care of Edwin W. Ely, Room 708, Department of Commerce, Washington.

S. A. E. to Entertain Airplane Experts

Experts are to present the latest available information on airplane design, construction and operation, in a number of addresses to be delivered at the national aeronautic meeting and dinner to be held by the Society of Automotive Engineers at the Hotel Astor, New York, during the afternoon and evening of Oct. 7, the day preceding the Pulitzer Prize Races at Mitchel Field, Long Island.

Manufacturers and Engineers Will Address Guests

The afternoon session is to be devoted to papers and discussion on the design and construction of racing and commercial planes and engines, and at the evening session following the dinner, the operation of aircraft in commercial air lines will be the subject of several addresses. The speaker at the dinner is to be C. M. Keys, president of the Curtiss Airplane and Motor Co. Harry L. Horning, president of the society, will preside and Henry M. Crane, of the General Motors Co., and past president of the society, will be toastmaster.

The president of the Aero Club de France, Monsieur P. E. Flandin, and Monsieur Louis Breguet, a prominent French airplane manufacturer, have accepted an invitation to attend the sessions and the dinner. The meeting is open to all persons seriously interested in aeronautics.

Engineering Council to Meet

The next meeting of the administrative board of the American Engineering Council will be held in Columbus, Ohio, Oct. 29 and 30, under the auspices of the Engineers' Club of Columbus. The president of the council, former Governor James Hartness, of Vermont, who has been recovering from a prolonged illness, is expected to preside.

The first session of the board will begin at 10 a.m. on Thursday, Oct. 29. The executive committee will meet Wednesday, Oct. 28. Chief among the topics to come before the board is the study of commercial aviation now being made by the council jointly with the Department of Commerce. Numerous reports of other activities of the council will be presented.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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It sometimes happens that an incident trivial in itself will change the orientation of the business mind because it is assumed to reflect a reversal of public opinion or the attitude of those who are supposed to be well-informed. This was the case with the overall parade and the Wanamaker price reduction that preceded and helped to precipitate the deflation of 1920-21. The issue of debentures offered by Marshall Field & Co., last week may also have an important although a dissimilar effect.

In itself the issue was a relatively small affair—only $17,500,000 debentures were offered. They run from three to twenty years and were sold on a basis which yields the buyers an average of about 4.80 per cent. But it is argued that they must have been sold to the bankers at about the equivalent of 5 per cent and that their sale indicates that a concern whose credit is impeccable and whose judgment ought to be superlatively good thinks that interest rates are about as low as they will go and that the present is an opportune time to make a loan that will run for a long period.

For these reasons the transaction has made a very definite impression and it is not too much to say that it has had a perceptible effect upon the money market because it has led many other business men to commence putting their financial affairs in order against a time of possible stringency. It may or may not be a significant coincidence that the weekly statement of the Federal Reserve Banks shows a decline to 72.9 in the reserve ratio and an increase of $153,000,000 in discounts. Arithmetically these changes are small but they are straws that may indicate the direction of the current.

Another incident that has set men to thinking is the acquisition of the John V. Farwell Co., of Chicago, by Carson, Pirie, Scott & Co. It is not sensational although it is important. Many other such consolidations have been effected recently, but this particular merger comes at a moment when attention has been directed to the centripetal tendency of big business under the present administration, and it is leading some to ask what will happen if the present tendency toward combination of banks and industries and transportation in big units is not checked.

It may be that the happenings referred to have attracted more attention in New York than elsewhere, but there is no doubt that they have caused a thoughtful pause in the stock market, where it is realized that trifles light as air may have an influence upon sentiment that is out of proportion to their weight.

This is not to say that the stock market has been weak or that it has declined. Such a statement would be inaccurate, but it is undeniable that the adventurous speculators who are buying stocks at the highest prices on record for many securities are becoming a little more conscious of their altitude and its dangers. But business outside of Wall Street is good and in some lines it is improving.

In most lines business is good but it cannot be said that prices are buoyant. For instance, price reductions ranging from 10 to 30 cents a yard were announced by the American Woolen Co. last week at its opening of spring, 1926, lines of women's wear. The wheat market seems inclined to fade away on the slightest pretext as it becomes plainer that our exportable surplus, small as it is, will have to be sold in competition with other exporting countries.

In the sugar trade there has been some "retrogressive progress." Cuban raws have declined to the lowest price of the season and at 2.32 cents a pound landed New York ex-duty they are within half a cent of the minimum of all time. The decline is attracting world-wide attention. It discounts the expectation of another large crop that has not yet matured.

The only other high points in the week's news are the unabated activity in building, some new land booms, including one in the British owned island of Nassau, another at Washington, D. C., and the sensational hegira to Florida as a result of which the passenger facilities of the railroads that serve that Elysium are over-taxed.

The recent strength in motor stocks is causing many to ask whether this is due to a real improvement in the motor industry, or whether it is merely another phase of stock exchange speculation. In this connection it is worth noting that, whereas the trade estimates place automobile production in August very close to the high records attained in July, the government estimate shows a reduction of almost 150,000 in the number of machines produced.

The news from Europe that has attracted most attention is that Lord Leverhume's art collection will compose the entire cargo of a ship that will shortly sail from Liverpool to New York. In this announcement the English newspapers seem to find convincing proof of America's superlative opulence. But they ignore the fact that when the treasures that the soap manufacturer collected are sold here our favorable balance of trade will be reduced by what they bring.

Caillaux has arrived and is welcome. As to how his proposals will strike our matter of fact President—*nous verrons*. Further comment would be premature and discourteous.

What's Doing in Industry

September proved to be another good month for the machine tool and allied machinery trades. While the total volume of sales was not as large as that in July and August, nevertheless there was a steadiness to the demand that leaves the impression that fall business will run along smoothly.

The greatest activity centers around Detroit, where sales to the automotive industry continue to provide machine tool dealers with plenty of action. Chicago also reports steady business, with a noticeable demand for milling machines. Milwaukee reports a demand fairly well maintained, quick deliveries being asked in most cases. In Cincinnati there has been a general improvement in the tone of the market, with new inquiries appearing frequently. Cleveland reports that buying is better than normal, with excellent prospects for fall business.

The South reports sales keeping up steadily, with an increase in the call for used machines. Philadelphia expects an active demand from industries now in process of expansion. New York dealers admit little change in the past ten days.

In most lines business is good, but it cannot be said that prices are buoyant. Adventurous speculators in stock markets are becoming conscious of their altitude and the dangers thereof, and a steadying of buying and selling may be expected.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Cleveland

Continued activity of buying of machinery and machine tools has featured the past fortnight in the Cleveland district. Although sales records show a slight decline in comparison with July and August, it is the general opinion of the trade that business is better than normal. Automobile manufacturers of Detroit were recent purchasers. Closing of export business for Cuba and Russia is also reported.

Several plants are working full quotas of night and day shifts in order to complete orders consummated during July and August.

The recent exhibit of machine tools and machinery in connection with the A. S. S. T. convention has borne fruit. Most of the exhibitors closed contracts during the show and many more are pending.

Cincinnati

An improvement in the general market tone in the past week is reported by Cincinnati machine tool manufacturers, with less lapse of time between inquiries and sales than there has been. The outlook is regarded as encouraging, and increased activity is expected.

Selling agencies report that the local demand for machine tools is growing better, but it is stated that the purchases are mostly confined to replacements and that general machinists are not yet beginning to make business extensions.

The feature of the general market seems to be the discarding of obsolete equipment and the purchase of more efficient tools, in order to cut down manufacturing costs. Concerns in the automotive industries have been the largest buyers in the past week, and an increased demand from this source is expected.

Sales to railroads have increased slightly, and while no large orders have been received from this source, the inquiries coming in show that the actual needs are great. An increased number of orders are coming from industrial plants, the majority of which are becoming more active.

Orders and inquiries are evenly distributed over the whole country.

Milwaukee

The demand for metal-working equipment appears to be fairly well maintained at the relatively satisfactory rate of August and September, with the automobile industry still looming up as the principal source of new business. A noticeable development is that motor car shops are becoming more and more insistent upon quick deliveries, and this has caused tool manufacturers to redouble efforts to get maximum production. In a great many instances it is the tool manufacturer who is able to guarantee the earliest delivery that is given the business, everything else being equal. There have been cases where the successful bidder for equipment has been given a premium or bonus for certain delivery.

Employment in the metal-working trade in the Milwaukee market showed a further slight increase during the past month, which is the direct result of the gradual improvement in the volume of business coming to foundries and machine shops. In this regard, too, the automobile industry is a contributing factor. This situation has led to some misgivings concerning the duration of the period of greater activity, but opinion seems to be that the automobile industry is proceeding along substantial lines, and that there is much more business for the machine tool trade in the foreground.

The demand for equipment from railroad shops is small, but there are scattering orders which are helpful in maintaining production schedules. The electrical industry is purchasing light tools, automatic machines and similar equipment.

There has been no great activity in the direction of enlarging industrial plants, and with few exceptions metal-working concerns have not found it necessary to make provision for increased capacity.

Philadelphia

The general tone reflecting business conditions in Philadelphia continued good last week, with economic indications favorable to an increase in the volume of transactions. Machinery and machine tool manufacturers and dealers have found this situation profitable, although actual orders have not indicated immediate results.

It is too early in the season now to forecast what the autumn may bring forth. A great many letters from various sections have been received and the inquiries for machinery are scattered. Generally speaking the orders now being received are not as plentiful as they were this time last year, and the inquiries do not reveal any greater hope than they did then. The general underlying conditions, however, appear to be better than they were twelve months ago, machinery dealers believe.

Manufacturers of small tools find small buying continues to be the rule among dealers.

Detroit

September sales of machinery and machine tools in Detroit, fell off slightly from those of July and August, but in spite of this business is much better than had been anticipated for this time of the year.

Automobile production continues constant to a remarkable degree, with many of the higher priced cars stepping up their schedules. Buying of equipment is rather general, with most of the automotive plants making purchases.

The Oakland Motor Car Co. has increased its daily production schedule from 150 to 300, but little added equipment had to be secured because the factory is machined up for such a production. Oakland has been buying some automatic milling machines and equipment for lining up cylinder blocks for the new light-six which will be brought out about the first of the year.

The Packard Motor Car Co. has issued some inquiries now on toolroom equipment, including lathes.

The Hudson Motor Car Co. is purchasing some automatic screw machines and thread millers. The Paige-Detroit Motor Car Co. is installing some cylinder equipment preparatory to production of its new product.

Small tools and lathes are being ordered by the Ford Motor Co. for both the Highland Park and the River Rouge plants.

Reo has bought a jig borer and a vertical shaper during the past week, while some shears are being installed at the Flint plant of the Buick Motor Co. Oldsmobile's recent purchases have been presses.

The new two million dollar factory extension of the Wilson Foundry and Machine Co., of Pontiac, Mich., has been completed and production of Knight engines has been started. New equipment will permit turning out 2,400 engines a day.

The Atlas Drop Forge Co., of Lansing, Mich., is adding extensive equipment to its power plant, including three boilers and some furnaces for heat-treating.

Employment in the Detroit automobile and accessory plants is at the highest point in the city's history, figures of the Employers Association show. The total is now above 250,000, an increase of more than 50,000 over last year.

Chicago

Dealers in machine tools and special machinery report business conditions little changed from those of a week ago. The volume of sales, while fairly good in some lines, is not so encouraging in others. In particular, woodworking machinery is moving slowly. Improvement is not expected until industrial production throughout the country shows a general speeding-up. On the other hand, inquiries for metal working machine tools are reported to be exceptionally satisfactory, the time of year considered. Inquiries are mainly for punch and drill presses and lathes.

The Illinois Central and Santa Fe railroads have recently placed orders for a number of tools, the first named to meet the requirements of its repair shops at Sioux City.

Demand for milling machines is being maintained on a basis that insures a good business for several weeks to come, one Mid-West manufacturing plant finding it necessary to operate overtime to fill orders.

New York

Business in machinery and machine tools continues steady, with the total volume of September slightly behind the August figure. September did not produce the volume that was expected, although new orders reached a satisfactory figure.

Manufacturers of electrical goods and hardware are busy and have come into the market for additional equipment to build up seasonal production.

The demand for small tools and miscellaneous shop equipment has fallen off, but this is not considered important at this time.

Railroad inquiries issued several weeks ago have materialized in the form of a few orders for shop and yard equipment, and orders for lathes and drilling machines are reported ready to close early in October.

Fruitful results of the New Haven and Cleveland machine tool exhibits are already apparent. Several dealers report that they have considerable business lined up as a result of the promotion work that was done at these conventions.

Southern District

Though sales are about the same as they have been the past month, an increase in the volume of inquiries for both used and new equipment is reported by dealers in the Southern district. In fact, most dealers in the district seem to agree that the outlook for the fall and early winter months in this section is the best it has been in the past four or five years.

The automotive industry is still doing construction work and there is an active demand for garage machinery, principally rebuilt or used equipment. Smaller machine shops are buying on a little better basis, inquiries from this source being quite active. Considerable of this business also is for used equipment.

What the Railroads Are Doing

The business of the Baldwin Locomotive Works indicates improvement in the general situation of the railroads and reflects better conditions throughout the country, Samuel M. Vauclain, president, said recently.

"Conditions are on the upturn, gaged by our business," he said, "but I would not care to admit that there has been much of anything the matter, taking the situation as a whole. Better crops, of course, are having a good effect everywhere and this improvement reaches through the transportation field to the locomotive manufacturing industry.

"But an important factor in the nationally increased demand for locomotive equipment is the industrial swing toward greater efficiency. Railroads are well up at the head of this procession and the roads serving the northwest are in the front rank. Railroads have the money to effect the necessary improvements. They are doing so and the result is likely to be a pitch of efficiency even greater than that now prevailing on our transportation machine."

The Chesapeake & Ohio R.R. has signed a contract with the American Locomotive Co. calling for the delivery of fifty heavy type Mikado locomotives at a cost of $3,250,000. Delivery will begin in December.

The Interstate Commerce Commission approved, on Sept. 22, a bond issue of $1,650,000 five per cent, refunding mortgage bonds, by the Wheeling & Lake Erie R.R.

The Louisville & Nashville R.R. has ordered twenty-four heavy locomotives from the American Locomotive Co. The Richmond Car Works has ordered one switcher and the H. L. Bruce Co. one Prairie type engine from the same company.

Indications are that the New Haven R.R. will show for August a surplus after charges of about $100,000 less than in July, or around $525,000. This compares with a surplus of but $279,991 in August, 1924, and surplus of $174,961 in the same month, 1923. This would bring eight months' surplus to about $3,800,000, against $801,834 in first eight months of 1924.

New Haven's traffic has been holding up splendidly. The coal movement in August was large in anticipation of the strike. September, however, will show a falling off in anthracite tonnage and this will be felt to increasing extent if the strike continues. Movement of other tonnage is heavy and passenger business has shown improvement. With operation of bus lines, and prospects of further expansion in this direction, the New Haven will check diversion of local passenger business.

August earnings of the Chicago & Eastern Illinois R.R., which draws much of its traffic from union soft coal fields, will show an increase over August of last year, T. C. Powell, president of the road reports.

"Although the movement of coal in our territory is 50 per cent below normal, the movement of freight is showing a steady increase. I am trying to work out a policy which will help diversify the nature of our traffic, which is now mostly mine products."

The operation of motor buses, he said, is being planned by the road between Chicago and St. Louis, as a means of meeting the growing competition in passenger traffic from private automobiles.

The New York, Chicago & St. Louis R.R. reports gross revenues of $4,677,895 for August, an increase of $244,831, compared with the same month last year. Net railway operating revenues amounted to $877,334, an increase of $19,859 for the month; net income, after charges, totaled $539,932, an increase of $19,713. The August ratio of operating expenses to gross revenues was 71.78 per cent., against 74.37 per cent. last year.

For the eight months ended Aug. 31, 1925, the system reports gross revenues of $35,525,062, an increase of $126,970 over last year.

Both gross revenues and net operating income of the Union Pacific System for August were slightly higher than in August last year, according to a statement made public last week.

The total operating receipts in August amounted to $18,161,823, compared with $17,925,132 the year before, an increase of $236,691, or 1.3 per cent. Increased expenditures for the maintenance of way and equipment accounts brought the total operating expenses for the month to $13,081,910, but a reduction of $341,180 in the charge for tax accruals enabled the company to report $3,454,312 in net operating income, against $3,246,546 in the corresponding month, a gain of $211,766, or 6.5 per cent. over that of August, 1924.

News of the Automotive Industry

The year 1925 will be the most prosperous year in the history of the automobile industry, according to the latest figures issued from Detroit. Except in a few instances the dollar volume of profits will be greater than in any other year for almost every leading producer. The years 1920 and 1923 stand out as marks with which motor companies' prosperity is commonly compared, but in neither year did the public receive for its money anywhere near the dollar value of car this year.

Production by automobile manufacturers shows no signs of falling off and is being maintained at a rate unexpected a short time ago. Steel manufacturers in Pittsburgh draw this conclusion from their order books which still show substantial tonnages of purchases by this industry which, after capacity production by the leading makers in the spring, showed practically no seasonal slump at the close of the summer.

The National Automobile Dealers' Association reports that on the average only 70 per cent of new cars sold this year are involved in taking in trade of an old car, against a percentage of 90 last year. This is taken as another testimonial to the prosperity of the country.

W. R. Morris, governing director and owner of Morris Motors, Ltd., England, after spending a week studying production methods in Detroit motor plants says he will install a number of these methods in his English and French plants.

Contract for the structural steel for the new Ford $4,000,000 assembling plant in Somerville, Mass., has been let. Other contracts for materials, it is understood, are to be placed soon from the Detroit headquarters of the Ford Motor Co.

This indicates that actual work of construction on the big plant will be started before long, this being largely contingent upon the completion of the storm drain which the city of Somerville is constructing on the land. It will probably take several weeks to finish this work.

The Curtiss Aeroplane and Motor Co. has received an order from the United States Government for 25 pursuit planes and 61 motors, aggregating more than $1,500,000. The company's plants are operating at capacity.

The stock holders of the Peerless Truck and Motor Corporation, at a special meeting on Sept. 22, voted to change the name of the company to the Peerless Motor Car Corporation, headquarters in Ohio. The corporation was a holding concern, and discontinued manufacture of trucks several years ago.

"From present indications, I think Willys-Overland will earn about $17,000,000 for the year before federal taxes," said John N. Willys, president of the Willys-Overland Co., in a recent interview. "This figure, of course, will include bond interest and everything up to federal taxes and preferred dividends. For the third quarter, I think we will conservatively earn about $3,500,000 and in the fourth quarter $2,500,000 or better. September will probably be the largest in our history, and the same will be true of October. We are producing between 900 and 1,000 cars a day. Sales continue to run well ahead of production. No further price cuts are contemplated by us at present. Our foreign business is better than it has ever been."

O. C. Hutchinson, general sales manager of the Hupp Motor Car Corporation, reports that Hupmobile eight sales in 1925 will exceed 15,000. Hupmobile has increased initial estimates for eight cylinder output over 50 per cent. Last December the company made plans to produce 10,000 of these cars during 1925. Production estimates have been exceeded every month since the first car was built.

Personals

FRITZ MEYER and E. BAUMANN, representatives of Sulzer Brothers, Winterthur, Switzerland, arrived in this country on Sept. 23 for a visit to study oil engines and high pressure steam installations. They intend to spend about two months in this investigation.

J. D. JONES, general manager of the Algoma Steel Corporation, has been elected a director of the Lake Superior Corporation, the Algoma Steel Corporation, and the subsidiary companies, including the Cannelton Coal Co.

CHARLES W. MOFFETT has been appointed general manager of the Barney Auto Parts Co., of New York. He was formerly vice-president of the Warren Gear Products Co., of Warren, Pa.

HERBERT V. BOSHEA, of New Haven, Conn., has been appointed general foreman of the Chrysler plant at New Castle, Ind.

ARTHUR A. BULL, chief engineer of the engine division of the General Motors Truck Co., Pontiac, Mich., has resigned.

FRED W. KULICKE has been appointed sales engineer of the Budd Wheel Co., to succeed B. W. Brodt who resigned. For the past nine years Mr. Kulicke has been connected with the Atwater Kent Manufacturing Co., of Philadelphia.

W. D. SAYLE, president of the Cleveland Punch and Shear Works, of Cleveland, has returned from Europe.

C. F. TAYLOR has been appointed to the engineering faculty of the Massachusetts Institute of Technology, and will assume his duties on Jan. 1. Mr. Taylor is plant engineer for the Wright Aeronautical Corporation, of Paterson, N. J.

J. L. JONES has been appointed chairman of the grey iron castings committee of the American Foundrymen's Association. Mr. Jones is manager of the experimental laboratory of the Westinghouse Electric and Manufacturing Co.

J. H. MAIN has been appointed sales representative in Detroit for the General Drop Forge Co., of Buffalo, N. Y.

H. B. BURR has been appointed factory manager of the Detroit branch of the Houde Engineering Corporation, of Buffalo, N. Y.

ANDREW GRAF has been appointed chief engineer of the United States Motor Truck Co.

O. T. LAWSON has been appointed purchasing agent for the Bendix Brake Co., of South Bend, Ind.

Obituaries

JAMES DEERING, of Chicago, former vice-president of the International Harvester Co., died on board the steamship Paris en-route to the United States, on Sept. 21. Mr. Deering had not been well for some time. He was 66 years old. He was educated at Northwestern University and the Massachusetts Institute of Technology. He was an officer of the Deering Harvester Co., founded by his father, until 1902, when the business was merged with other leading harvester interests into the International Harvester Co., of which he became vice-president. He was later president of the International Harvester Co., of New Jersey.

Of recent years he had not been active in business and had made his home at Miami, Fla.

HENRY ROSE, for many years sales agent in the Philadelphia district for the American Steel and Wire Co., died suddenly at his home in that city on Sept. 17.

DR. EDWARD D. CAMPBELL, an honorary member of the American Society for Steel Treating, and a member of the faculty of the University of Michigan, died on Sept. 19 at his home in Ann Arbor, Mich.

Business Items

The Cincinnati Electric Tool Co. has been reorganized with Joseph Wolf as president and treasurer. R. K. Le Blond has been elected vice-president and E. G. Schultz, secretary.

The Service Tool Works, of Indianapolis, has purchased the Wallace Machine Works. The consolidated company will specialize in the manufacture of dies and punches.

The Independent Lock and Key Co., of Leominster, Mass., has purchased the plant and properties of the Universal Grinder Co., of Fitchburg, Mass. The operations of the combined organizations will be concentrated at Fitchburg.

The Bullard Machine Tool Co., of Bridgeport, Conn., announces the appointment of the following sales representatives: L. G. Daniels, Chicago; J. M. Welch, Pittsburgh; F. E. Hatch, Jr., Syracuse; and F. A. Thompson, Detroit.

Manning, Maxwell & Moore, Inc., of New York, has been appointed exclusive agents for the grinding and polishing machines manufactured by the Bridgeport Safety Emery Wheel Co., of Bridgeport, Conn. This contract does not apply to the sale of grinding wheels.

Wilson & Brown, Inc., of New York, have been appointed New York sales representatives for the R. K. Le Blond Machine Tool Co., of Cincinnati.

The Carle Machinery Co., of Detroit, has been appointed to represent the D. H. Luehrs Co., of Cleveland, manufacturer of special automatic production machinery, in the Detroit territory.

AN IMPOSTOR

Machine tool manufacturers and dealers are warned against a man who is going about in the trade attempting to borrow money and cash checks, representing himself as the general manager of the United Castings Co., a Los Angeles concern.

This man visited the New York market last week and almost succeeded in getting several hundred dollars. He carries forged business cards bearing the name of W. A. E. Noble. His real name is Charles W. Hirsch, and there is a warrant out for his arrest for cashing bogus checks with machinery concerns in several Western cities.

The Ex-Cell-O Tool and Manufacturing Co., of Detroit, has appointed the following sales representatives: the W. A. Laub Co., Philadelphia; O. H. Lorange, Boston; the I. M. Lytle Co., San Francisco; J. W. Mull, Jr., Indianapolis; the Triplex Machine Tool Co., New York; Walter Phillips, Letchworth Herts, England.

The Stephens-Adamson Manufacturing Co., of Aurora, Ill., has secured sole right to market conveyor and power transmission chain made from "Farrell's 85" steel.

The Lathrop-Trotter Co., of Cincinnati, sales agents in that territory for the Diamond Power Specialty Corporation, of Detroit, announces that its district has been extended to take in Indianapolis and adjacent territory in central and southern Indiana.

Joseph T. Ryerson & Son, Inc., of Chicago, announces that it has acquired full rights covering the line of horizontal drilling and boring machines manufactured and sold by the Harnischfeger Corporation, of Milwaukee.

Motch & Merryweather, of Cleveland, have taken the agency in that territory for machine tools, hobs, grinders and other products manufactured by the Union Twist Drill Co., of Athol, Mass.

The Air Reduction Sales Co., of New York, has established a new sales office at 1296 Forest Home Ave., Milwaukee, in charge of J. S. Strate, as district manager. This new office will serve parts of Wisconsin, Michigan, Illinois and Iowa.

The Brown Instrument Co., of Philadelphia, announces the opening of a new branch office at 363 New High St., Los Angeles. S. F. Godfrey, formerly of the Braun Corporation, has been placed in charge of this office.

Pamphlets Received

Hacksaw-ology. Published by the Simonds Saw and Steel Co., Fitchburg, Mass. This booklet contains valuable information about the hacksaw blade, its uses and care. The best methods for cutting different kinds of metals by power or hand are explained in non-technical terms. Proper selection of blades for various cutting operations, and uses of lubricants in power operations are fully given.

Net Profits from Small Lots. Published by the Warner & Swasey Co., Cleveland, Ohio. This booklet is intended to show ways to cut down production time on turret lathes used for small lots of five to fifteen pieces. Illustrations, blueprints and statistics are given for the different set-ups.

Trade Catalogs

Air Tools. The Buckeye Portable Tool Co., 135 Wayne Ave., Dayton, Ohio. A circular has been issued listing the various applications that have been made of the Hercules principle of design for air tools. Portable drills, grinders and buffers are included.

Electrical Supplies. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. 1,224 pages, 8 x 10½ in. 4,500 illustrations. Cloth bound. The 1925-1927 edition of the Westinghouse catalog of electrical supplies has been published and is being distributed. This edition lists a considerable amount of new equipment developed during the past two years for central stations, electric railways, industrial plants, mines, contractor-dealers and architects. Each item of equipment is illustrated with photographs and with drawings to show the construction of the apparatus. Specifications give the complete details as to size and capacity. The application, distinctive features, construction and operation are included in the preliminary description of every model. Each group of similar apparatus is preceded by a thorough explanation of the purposes, features and general handling of the particular group or type in question. To a very definite degree the catalog serves as a text-book on electrical products.

A thumb-index facilitates the locating of the various departments of electrical supplies and it is accompanied by an index to the sections covered. The subject index is very complete and it lists alphabetically, by name, the products of the company. A separate index is also included to show the paging of the style numbers.

The catalog is artistic in its arrangement and the typography is excellent. The weight of the book is reduced by the use of light-weight paper.

Ball Bearings. The Fafnir Bearing Co., New Britain, Conn., have published Catalog No. 26 on the industrial and textile applications of Fafnir ball bearings. This catalog, with 72 pages, 8½ x 11 in., shows the economies realized by the use of ball bearings by means of charts and illustrations. The ball bearing hanger-box and pillow-block sections are well illustrated by drawings and photographs, as are many other applications of a similar nature. Tables give the specifications and prices for each model included in the catalog. A general index lists the various applications of the Fafnir bearings.

Threading Dies. Jones & Lamson Machine Co., Springfield, Vt. Form No. 45 is devoted to the description of the features of Hartness automatic dies, high-speed series. This 12-page bulletin contains photographs and drawings of details to show the design of the dies.

Electrical Tools. The United States Electrical Tool Co., Cincinnati, Ohio. A bulletin has been issued to describe the portable electric screw, nut and stud drivers manufactured by this company. Tables of capacity for the tools are included as well as the specifications given for each model. A data table lists the size of the drill to use in hard and soft woods for the pilot hole for each size of screw.

Regulators. The Alexander Milburn Co., 1416-1428 West Baltimore St., Baltimore, Md. Bulletin No. 200A describes the high-pressure regulators for air, acetylene and other gas tanks, which are manufactured by this company. Illustrations and a short description of each model are given.

Control Pyrometers. The Brown Instrument Co., 4501 Wayne Ave., Philadelphia, Pa. Catalog No. 87 describes the various models of Brown automatic temperature-control instruments for indicating, recording, alarm and signalling. Many pages are devoted to photographs and descriptions of actual installations of Brown equipment, the rest of the 40 pages give details, photographs and diagrams of the various models in this line of equipment.

Drilling & Tapping Machines. The Luehrs Co., 118 St. Clair Ave., N. E., Cleveland, Ohio. A folder has been published to describe the construction and design features of the Luehrs high-speed drilling and tapping machine for production work.

Screw Machines. The Cleveland Automatic Machine Co., Cleveland, Ohio. Treatise No. 9 describes the Cleveland multiple-spindle automatics. Many illustrations and tables are included.

Forthcoming Meetings

National Safety Council. Fourteenth annual safety congress, Cleveland, Sept. 28 to Oct. 2. A. A. Mowbray, director, 168 N. Michigan Ave., Chicago.

American Gear Manufacturers' Association. Semi-annual meeting, Oct. 1, 2 and 3, West Baden Springs Hotel, West Baden, Ind. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Annual meeting, State Fair Grounds, Syracuse, N. Y., Oct. 5 to 9. C. E. Hoyt, secretary, 140 So. Dearborn St., Chicago.

Motor and Accessory Manufacturers' Association. Fall meeting, Prince Edward Hotel, Montreal, Canada, Oct. 14 to 16. M. L. Heminway, general manager, 250 West 57th St., New York.

National Industrial Advertisers' Association. Annual meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., Oct. 19 to 21. W. A. Wolff, chairman, the Western Electric Co., 195 Broadway, New York.

Management Week. Conducted jointly by five societies—The American Society of Mechanical Engineers, The American Management Association, The National Association of Cost Accountants, The Taylor Society and the Society of Industrial Engineers. Week of Oct. 19 to 24. W. L. Conrad, of the A. S. M. E., is chairman of the joint committee.

American Welding Society. Exposition of welding equipment and accessories, Massachusetts Institute of Technology, Cambridge, Mass., Oct. 21, 22 and 23. R. L. Browne, chairman, 141 Milk St., Boston, Mass.

American Society of Mechanical Engineers. Annual meeting, Engineering Societies Bldg., 29 West 39th St., New York City, Nov. 30. to Dec. 3. Calvin Rice, secretary, Engineering Societies Bldg., New York.

National Exposition of Power and Mechanical Engineering. Fourth annual event, Grand Central Palace, New York City, Nov. 30 to Dec. 5. Charles F. Roth, manager, International Exposition Co., Grand Central Palace, New York City.

American Association for the Advancement of Science. Annual meeting. Kansas City, Mo., Dec. 28, 1925, to Jan. 2, 1926. Burton E. Livingston, secretary, Smithsonian Institute Bldg., Washington, D. C.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Pig iron buying active but in small tonnage lots; prices firmer. Finished steel market steady, with little tendency to climb. Prompt deliveries required on most orders placed. Sheets, pipe, wire products and tin plates lead the market in demand. Steel bars remain firm at $1.90@$2; shapes, same as bars and plates, $1.80@$1.90 per 100 lb., Pittsburgh. Chances of a rise are more in favor of plates than shapes from present indications.

Non-Ferrous Materials—Copper is firmer at present levels and zinc shows tendency to advance, although the former is down ⅛c. and the latter, ⅛c. per lb., compared with quotations as of Sept. 18. Tin is quiet and lead prices remain unchanged. Prices of zinc sheets, solder and babbitt metal are firmer in the Middle West; linseed oil is down 7c. per gal. Fabricated brass and copper are steady in New York, Cleveland, Chicago.

(All prices as of Sept. 25)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$23.05
Northern Basic	22.27
Southern Ohio No. 2	22.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	19.00@19.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.26
Virginia No. 2	29.17
Basic	21.16
Grey Forge	....
CHICAGO	
No. 2 Foundry local	22.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.77
Basic	20.77
Bessemer	20.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	4.90@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.25@2.30	3.89	3.00	3.50
No. 12	2.30@2.35	3.94	3.05	3.55
No. 14	2.35@2.40	3.99	3.10	3.60
No. 16	2.45@2.50	4.09	3.20	3.70
Black				
Nos. 17 to 21	2.90@3.00	4.15	3.60	3.80
Nos. 22 to 24	2.95@3.05	4.20	3.65	3.85
Nos. 25 and 26	3.00@3.10	4.25	3.70	3.90
No. 28	3.10@3.20	4.35	3.80	4.00
Galvanized				
Nos. 10 and 11	3.20@3.30	4.35	4.00	4.00
Nos. 12 to 14	3.30@3.40	4.45	4.10	4.10
No. 16	3.45@3.55	4.60	4.25	....
Nos. 17 to 21	3.60@3.70	4.75	4.40	4.40
Nos. 22 to 24	3.75@3.85	4.90	4.55	4.55
No. 26	3.90@4.00	5.05	4.70	4.70
No. 28	4.20@4.30	5.35	4.95	5.00

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
3½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches — External	Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ¼-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
¼	$0.15	50%	⅞	$0.18	35%
⅜	.16	45%	1	.19	31%
½	.17	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.30 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.00	....	4.00@4.65
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.05	....	....
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.35	8.25	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	3.80	3.60
Cold drawn flats, squares	4.65	4.30	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	60%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to 1/4, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.00
Tin, 5-ton lots, New York			59.62½
Lead (up to carlots) E. St. Louis	9.25	New York	10.25
Zinc (up to carlots) E. St. Louis	8.87½	New York	8.62½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	18.00	20.00	....
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	20.25	17.00	16.75@17.00
Copper bars, base	21.87½	21.50	21.87½
Copper tubing, base	24.75	25.50	24.75
Brass sheets, base	19.12½	19.00	19.12
Brass tubing, base	23.75	23.75	23.75½
Brass rods, base	16.87½	16.87½	16.87
Brass wire, base	19.62½	22.50	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1–15 ton lots	28.00	28.00	28.03
Zinc sheets (casks)	11.25	12.00	11.27
Solder (½ and ½), (case lots)	39.50	39.00	38@42
Babbitt metal (83% tin)	60.00	68.75	58@63
Babbitt metal (35% tin)	28.00	22.50	30@35
Nickel (ingots) f.o.b. refinery	31.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	38.00	.....	.....
Nickel (shot) f.o.b. refinery	32.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.50@13.00	11.75	12.00@12.50
Copper, heavy, and wire	12.00@12.37½	11.50	11.25@11.75
Copper, light, and bottoms	10.00@10.50	9.75	10.25@10.75
Heavy lead	7.75@ 8.25	7.50	7.75@ 8.25
Tea lead	6.50@ 7.00	4.50	6.25@ 6.75
Brass, heavy, yellow	7.50@ 8.00	7.25	7.75@ 8.25
Brass, heavy, red	9.50@10.00	9.75	9.25@ 9.75
Brass, light	6.50@ 7.00	6.00	7.25@ 7.75
No. 1 yellow rod turnings	8.25@ 8.50	8.00	7.75@ 8.25
Zinc	5.00@ 5.50	4.00	4.50@ 5.00

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
	Coke Plates—Primes.			
100-lb.,	14x20	6.50	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.25	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@ .15½	.18	.17
Wiping cloths, washed white, per lb	.17	36.00 per M	.15½
Sal soda, per 100 lb. keg	2.25	2.25	2.75
Roll sulphur, per 100 lb. keg	3.75	3.75	4.50
Linseed oil, per gal., 5 bbl. lots	1.08	1.15	1.05
Lard cutting oil, 25% lard, per gal.	.55	.50	.72
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price. 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40%	40%	30–10%
Heavy grade	30–10%	35%	30–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50–5%	50–10%	50%
Second grade	50–10–5%	60–5%	50–10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold finished shafting	per lb.	.0415	.0415	.0415
Brass rods	per lb	.1687½	.1687½	.15
Solder (½ and ½)	per lb.	.395	.395	.38
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40%	40%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	50%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.46	$5.84	$5.00
Emery paper	10.71	11.00	11.90
Emery cloth	29.48	31.12	32.75
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.41	1.40
Cloth	3.55	2.67	3.55
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.50@4.00
Coke, prompt foundry, Connellsville	per net ton		4.50@4.75
White lead, dry or in oil	100 lb. kegs		New York, 15.75
Red lead, dry	100 lb. kegs		New York, 15.75
Red lead, in oil	100 lb. kegs		New York, 17.25

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1⅛ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%. Machine bolts, up to 1x30-in., with cold punched and hot-pressed hex. nuts, also button head bolts with hex. nuts are $3.60@3.75 per 100 lb. at Cleveland.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{7}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses; with hex. heads, $4.65 per 100 lb. net at Chicago.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x½-in., 2c. each. Discount 70% for $\frac{3}{16}$-in. and smaller and 65% for ¼-in. and larger.
Case hardened ¼x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ⅞-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in., $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ¾-in. dia., 75c.; 1-in. long and shorter, 75c., longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses; ½-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Conn., Danielson—Town, F. A. Jacobs, Chn.—manual training equipment for Killingly high school.

Mass., Boston — Schoolhouse Dept., City Hall, J. H. Mahony, Chn.—complete welding and cutting equipment for Boston Trade School, Parker St., Roxbury and sheet metal working machinery for Mechanical Arts High School, 10 Scotia St. here.

Mo., Springfield — Standard Semi-Steel Foundry Co., Clinton, Okla., C. T. Wilks, Gen. Mgr.—5 and 10 ton traveling cranes for proposed new foundry here.

N. Y., Buffalo—Globe Woven Belting Co., 1396 Clinton St.—machinery and equipment for the manufacture of woven belting.

N. Y., Buffalo — Niagara Clock Co., 40 Laird Ave.—machinery and equipment for the manufacture of clocks.

N. Y., Buffalo—Rice & Adams Corporation, 180 Chandler St., O. Adams, V. Pres. equipment for the manufacture of dairy machinery.

N. Y., New York—Logan Construction Co., 15 Park Row—10 ton, 26 ft. span, overhead crane with 3 hp. motors.

O., Cleveland—Bd. of Education, F. G. Hogen, Dir. of Schools—metal and woodworking machinery, lathes and foundry equipment for junior high school at East 120th St. and Kelton Ave.

O., Cleveland—Deming Mfg. Co., c/o J. Wint, 1777 East 87th St.—No. 2 B. & S. milling machine (used.)

O., Columbus—E. A. Prentice Lumber Co., 441 North Park St., E. A. Prentice, Gen. Mgr.—improved Phillips frame machine, 16 to 20 in. joiner, single end tenoner, 24 to 30 in. servicer, 42 in. 3 drum sander, 2 mortisers, 30 in. emory wheel, 30 in. band saw, 3 x 8 glue press, self feed rip saw, fifteen 3 to 20 hp. motors (used.)

O., Columbus — Universalite Co., 68 Stauring St., A. Hoffman, Pres., (auto accessories)—14 in. lathe, bench miller, bolt threader, 2 drill presses, etc. for new plant.

Wis., Kiel—Kiel Woodenware Co.—woodworking machinery for proposed new plant.

Wis., Milwaukee—Birch Saxophone Shop, 409½ Wells St.—lathe 10 or 11 in. swing, 24 or 30 in. between center.

Wis., Oshkosh—Fox River Valley Assn. of the Blind, 303 Gertrude St., Kaukauna, N. Feldmann, Treas.—broom making machinery and motors for proposed new plant.

Wis., Polar—T. D. Kellogg Lumber Co.—sawmill machinery to replace fire loss.

Que., Montreal—E. Corbeil, 1 Lachapelle St.—matcher and other machinery for saw and planing mill.

Que., Montreal—Fort St. Denis, 631 St. Zotique St. E.—miscellaneous tools and equipment for repair and service garage.

Que., Verdun—A. Berube, 496 Mullarkey Ave.—lathe and air compressor.

Opportunities for Future Business

Ark., Fayette Junction (Vale P. O.)—J. P. Brower, Fayetteville, plans the construction of a woodworking plant here.

Calif., Haywood—State Highway Comn., Sacramento, plans the construction of a new maintenance station including machine shop for the repair of highway equipment on Center St. near Mattox Road, near here.

Calif., Santa Monica—Edgewater Club of Santa Monica, plans the construction of a 5 story, 100 x 108 ft. garage at Ocean Ave. and San Vincente Terrace. Estimated cost $150,000. L. Rally, 1019 Wright and Calendar Bldg., Archt.

Conn., Bristol—The Root Co., Church St. Ext., awarded contract for the construction of a 4 story, 55 x 125 ft. factory for the manufacture of hinges, etc. Estimated cost $125,000. Noted Sept. 17.

Ill., Chicago—Statler Garage Corporation, 802 West Roosevelt Road, will soon award contract for the construction of a 2 story, 101 x 211 ft. garage at 2415 North Clark St. Estimated cost $150,000. M. O. Nathan, 123 West Madison St., Archt.

La., Shreveport—Texas & Pacific Railway Co., 1003 Texas & Pacific Bldg., Dallas, awarded contract for the construction of a group of buildings including a roundhouse, machine and blacksmith shops, car repair sheds, etc. Estimated cost $200,000. E. F. Mitchell, Ch. Engr.

Mass., Andover—J. F. McDonough, 32 Park St., will build a 1 story, 130 x 200 ft. repair and service garage. Estimated cost $100,000. H. Petzold, Bay State Bldg., Lawrence, Archt.

Mass., Cambridge—J. B. Johnson, Rindge Ave., awarded contract for the construction of a 1 story, 75 x 100 ft. repair and service garage. Estimated cost $75,000.

Mass., Dorchester (Boston P. O.—Skinner Organ Co., Sydney St., awarded contract for the construction of a 2 story factory at Sydney St. and Crescent Ave. Estimated cost $40,000. Noted Sept. 3.

Mass., Dorchester (Boston P. O.) — Thompson Wire Co., 41 Mildred Ave., is having plans prepared for the construction of a 1 story addition to factory. Estimated cost $40,000. Brainard & Leeds, 89 Franklin St., Boston, Archts.

Mass., Everett (Boston P. O.)—Jackson Door & Window Co., 95 Canal St., Boston, awarded contract for the construction of a 2 story, 101 x 211 ft. garage at 2415 North Clark St. Estimated cost $150,000. M. O. Nathan, 123 West Madison St., Archt. Noted Sept. 3.

Mass., Gardner — S. Bajonski is having plans prepared for the construction of a 2 story, 85 x 100 ft. repair and service garage. Estimated cost $85,000. A. J. Smith, 142 Lunenberg St., Fitchburg, Archt.

Mass., Roxbury (Boston P. O.)—Gateman & Yarchin, 43 Tremont St., Boston, is receiving bids for the construction of a 1 story, 80 x 250 ft. repair and service garage at 3293 Washington St., here. Estimated cost $50,000. S. S. Eisenberg, 46 Cornhill, Boston, Archts.

Mo., Kansas City—E. Scott, Los Angeles, Calif., will build a 2 and 3 story, 66 x 138 ft. garage at 920 Locust St. Estimated cost $150,000. Work to be done under the supervision of G. F. Green, 420 Rialto Bldg., Archt. Noted Sept. 17.

Mo., St. Louis—G. T. Burdeau Realty Co., 801 Chestnut St., will soon receive bids for the construction of a 2 story garage and repair shop at Delmar and Rosedale Sts. Estimated cost $250,000. People's Motorbus Co., 3615 Forest Park Blvd., lessee. Noted Apr. 23.

Mo., St. Louis — Southern Wheel Co., Commonwealth Bldg., Pittsburgh, Pa., is making preliminary surveys for the construction of a group of buildings for a car wheel plant at Goodfellow St. and Terminal R.R. here. Estimated cost $250,000.

Mo., Springfield—Standard Semi-Steel Foundry Co., C. T. Wilks, Gen. Mgr., Clinton, Okla., is having preliminary plans prepared for the construction of a 1 story, 65 x 200 ft. foundry on Chase St. here. Estimated cost $40,000. Private plans.

N. J., Trenton—Public Service Production Co., Terminal Bldg., Newark, plans the construction of a 1 story, 64 x 89 ft. garage at Chauncey and Willow Sts. Estimated cost $50,000. Company engineers in charge.

N. C., Morganton—The Table Rock Furniture Co., plans the construction of a furniture factory. Estimated cost $200,000.

O., Akron—Mankin-Ferris Co., 422 West Exchange St., awarded contract for the construction of a 3 story, 76 x 130 ft. garage on West Market St. Estimated cost $150,000.

O., Alliance — Alliance Toy & Specialty Co. has had plans prepared for the construction of a 1 story factory for the manufacture of steel and wooden toys. Estimated cost $50,000.

O., Ashland—E. Myers & Bro. Co., P. A. Myer, Pres., awarded contract for the construction of a 5 story, 170 x 180 ft. factory for the manufacture of pumps and gears. Estimated cost $200,000. Noted Sept. 17.

O., Cedarville — R. Wolford, has had plans prepared for the construction of a 2 story, 50 x 100 ft. garage and service station. Estimated cost $85,000. Shelling & Eastman, 926 Fairbanks Bldg., Springfield, Archts.

O., Cleveland—The Lang Body Co., C. E. Lang, Pres., 3038 West 106th St., awarded contract for the construction of a 1 story, 80 x 182 ft. addition to factory for the manufacture of auto bodies, on West 106th St. Estimated cost $60,000. P. Schmidt, 4500 Euclid Ave., Archt.

O., Cleveland—W. S. Tyler, East 36th St. and Superior Ave., awarded contract for the construction of a 2 story, 38 x 40 ft. foundry, etc., for the manufacture of ornamental iron and bronze. Estimated cost $40,000.

Ore., Portland—Clark & Wilson Lumber Co., Linnton St., is having plans prepared for the construction of an 8 or 10 story plant. Estimated cost $500,000. Architect and engineer not selected.

Pa., Homestead—Carnegie Steel Co., Carnegie Bldg., Pittsburgh, plans the construction of a 1 story, 50 x 110 ft. storage building here. Estimated cost $150,000. Carnegie Land Co., Frick Annex, Pittsburgh, Engr. Noted June 4.

Pa., Latrobe—Latrobe Electric Steel Co., awarded contract for the construction of a 1 story, 60 x 400 ft. addition to plant. Noted Sept. 17.

Pa., Pittsburgh—Pittsburgh Parking Co. Inc., c/o Mellon Stuart Co., Oliver Bldg., awarded contract for the construction of a 6 story, 90 x 160 ft. garage at Pennsylvania Ave. and Evans Way. Estimated cost $400,000. Noted Sept. 10.

Tex., Dallas—Texas & Pacific Railway Co., c/o E. F. Mitchell, Ch. Engr., Texas and Pacific Bldg., awarded contract for the construction of a group of buildings including a roundhouse, repair and machine shops, repair sheds, etc. Estimated cost $135,000.

Wis., Kiel—Kiel Woodenware Co., is having plans prepared for the construction of a 1 story, 40 x 125 ft. factory. Estimated cost $30,000. W. F. Neumann, 114 Grand Ave., Milwaukee, Archt. This corrects report of Sept. 24 issue.

Wis., Marshfield—Wisconsin Butter Tub Co., West 9th St., is receiving bids for the construction of a 1 story, 56 x 140 ft. factory. Estimated cost $40,000. G. A. Krasin, Central Ave., Archt.

Wis., Oshkosh—Fox River Valley Assn. of the Blind, N. Feldmann, Treas., 303 Gertrude St., Kaukauna, plans the construction of a 2 story broom factory. Estimated cost $50,000. Architect not selected.

Wis., Polar—T. D. Kellogg Lumber Co., plans the construction of a 2 story sawmill to replace fire loss. Estimated cost $50,000. Architect not selected.